The Foundry

for July

Why More Captive Foundries?

WHERE foundrymen gather, one question always arises, soon or late. Why do users of castings continue to build or expand foundry departments? There are about 1500 such departments, dubbed *captive foundries* by NRA phrase-makers and about 3500 foundries depend upon jobbing casting orders. Editors of THE FOUNDRY hold no brief for jobbing shops, for captive foundries, nor any other group or section of the industry where conflicting interests arise. The best good of the entire foundry industry is of prime importance. **On that basis—**

Why do *captive foundries* exist?

Why do so many castings users spend their money to go into the foundry business?

What makes them believe such investment of their capital will pay them better than the same money would return in their own line of business?

Are they so much more capable than men already in the foundry business that rewards can be expected beyond the dreams of present foundrymen?

How can the gilded possibilities be so hidden from the foundryman, yet so apparent and enticing to the business man who runs some successful ribbon, cigar, implement, railroad or automobile company?

Is great talent enticed into the field after the buyers of castings have given jobbing foundrymen every chance to serve and make handsome profits for themselves?

Will the owners of *captive* foundries write and tell the editors, confidentially, why?

Why is the *captive foundry?* **And—**

Can it be that only inferior beings go into the jobbing foundry business?

Is the user forced to come in by poor quality or service?

Does the foundryman invite him in?

Does the jobbing foundryman want more customers to make their own castings?

What does he think he would do about it?

With the foundry capacity of the country, with few exceptions, running only about half time, why build more capacity?

Must the investment already tied up in jobbing foundries be made unprofitable?

Must it eventually be lost?

Must all jobbing foundries be plowed under by the profit lust of castings buyers?

Have jobbing foundries no place in the industrial and manufacturing structure of American business?

Let us have your answers.

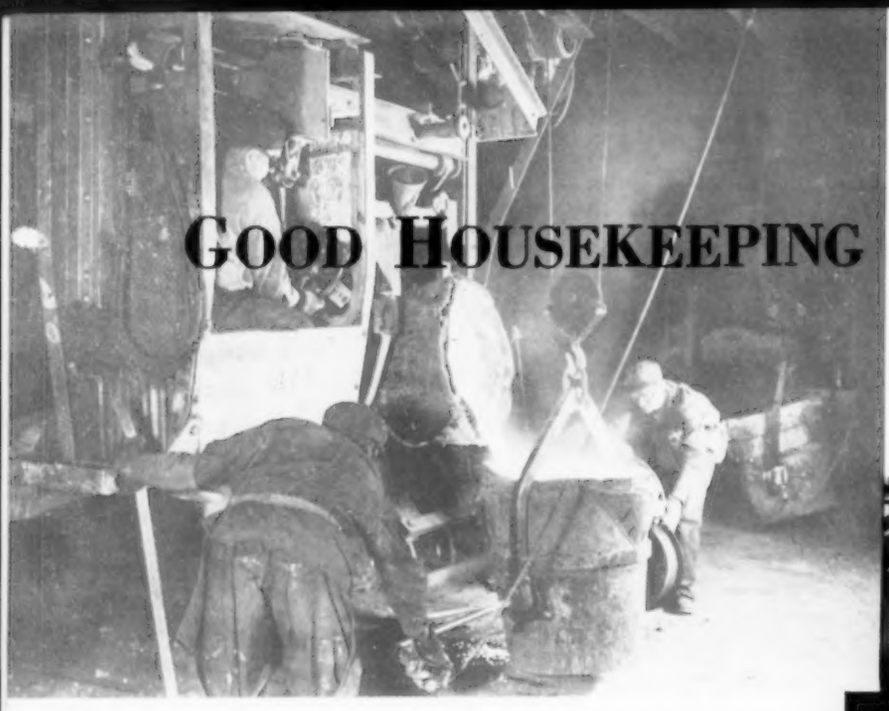
What Is It?

WHAT is price fixing? Combined with the term monopoly, price fixing incites to chest pounding and scorn fingering by politicians of every rank and party. But just what is it?

When the four grocers in a small town all charge 10 cents a pound for beans, is it price fixing? When all the department stores in a city ask $41.69 for an identical animal hide, is that price fixing? When forty dealers selling domestic coal get $8.65 a ton delivered in the family basement, what is it?

Price stabilization is the answer in each of these cases. But where does price stabilization stop and price fixing start? Is it when rails are purchased, or steel bids are submitted on public works? Is price fixing only encountered when certain purchasers are concerned? And is our thinking this year different from that in 1932-1933 when the deviation from recognized or *fair and reasonable* price was dubbed *chiseling* and those who failed to maintain the recognized level on batteries or what not were malefactors. In all seriousness, is not some price stabilization in the public interest? The sin is in excess, the attempt to levy tribute through monopoly. Does not competition from without any industry, between competing materials, processes and products eliminate that fear?

Editor



GOOD HOUSEKEEPING IN THE FOUNDRY PAYS DIVIDENDS

By E. O. JONES
Director, Safety and Hygiene Section
American Foundrymen's Association

Presented at the Seventh All-Ohio Safety congress held at the Deshler-Wallick hotel, Columbus, O., June 3

TWENTY years ago few foundry operators thought of cleaning the interior structure of their foundry buildings. An accumulation of dust on wooden beams was considered good fire protection. Foundry equipment manufacturers designing and furnishing equipment for various foundry operations, gave little thought to dust suppression.

We have come a long way in the last 10 years. The foundry industry and those who supply it with equipment have done a commendable job. The exhibit of the present day foundry equipment at the recent American Foundrymen's association convention in Detroit is indicative of the rapid strides made in our industry.

Many Responsibilities Concern Everyone

The purchase of equipment is just a part of the good housekeeping problem and there are many other responsibilities in which all are concerned. We all appreciate that control of dust presents many difficult problems. We know from past experience human ingenuity gradually will devise ways and means to solve the mechanical problems.

It took considerable time to develop efficient safety guards for our machinery. Time and experience also has developed practical leggings, safety shoes, goggles and protective respiratory devices. When all the facts become known, all means of prevention should be adopted by the employer. At the same time the employe who elects at his own option to work at a certain trade should recognize his personal responsibility to minimize the hazard when one is known to exist by using the protective devices supplied him by the employer.

In starting a good housekeeping program, it might be well first to remove from the foundry everything that is not needed in the production of castings and which might be placed in the category of dust and dirt catchers. Every molder should be instructed to clean up around his own particular bench. He may have two or three shelves which probably support an accumulation of various materials, possibly some cores left from a job that probably ran out a year ago but hopes are held that it may come back. Probably two or three boxes contain nails, chaplets, chills, etc. No doubt the molder also has a wooden cupboard holding various things which may or may not have some sentimental value.

It also might be well to sell or dispose of the old molasses and parting barrels; get the gaggers, clamps and sling chains up off the floor, etc. Many foundries today are building racks in which that type of material is kept in an orderly manner. There seems to be no good reason why a production molder should have

to hunt through a pile of gaggers or clamps looking for the particular size which may be needed. Sling chains should be kept on chain racks instead of reposing around the base of columns.

During this survey of the plant, one also might find a few scrap castings hidden around that might just as well go back to the melt to become a better casting.

Everybody dislikes to move flasks out, especially large ones, because, without fail, that will be the job that will be right back in. If business is getting a little slack it might help the housekeeping program to remove all flasks not in use.

After all the excess material has been removed, get into the corners and remove the surplus sand. The amount of material which accumulates will be surprising. If this is done on Saturday, be sure to be on the job early Monday morning. Otherwise, you will have a lot of it right back in the foundry.

Also suggest to molders that they clean off their machines at the end of the day's run while the sand is still damp. All are familiar with the first act of a molder when he arrives at his bench. With the air hose he proceeds to remove everything possible in the way of dust and dirt from his equipment. The accumulation on the shelves just discussed usually gets its share of the air force.

Consider Menial Tasks of Laborers

A molder usually will wet down a sand pile but seldom pays much attention to his floor or gangway. When he has completed his day's work in some plants where it is allowed, his trusty air hose again is called on and he proceeds to take a compressed air bath. This practice should not be tolerated for more reasons than the atmosphere which it creates.

The menial tasks of the foundry laborers also should be considered. These workers should not be allowed to sweep or shovel until the material which they are removing is wet down thoroughly. It is not unusual to find, in cleaning departments where considerable money has been spent for the installation of proper ventilating systems, men with brooms and shovels cleaning up without giving any thought to the amount of dust they are creating.

Many foundries today are using successfully a water spray for wetting down. That equipment was developed by the Falk Corp., Milwaukee, for their own use. This spray uses a combination of air and water, which is expelled through a cutting torch tip. Another device recently introduced uses a cheap grade of oil for spraying foundry floors. That device can be used in many departments of the foundry. Oil, when properly applied, has many advantages over water, as it does not dry out as quickly. Some foundries have used calcium chloride but only in places where it will not come in contact with molding sand.

Unfortunately, shakeout and crane men, many times give little attention to the results of their thoughtlessness. Dump buckets are dumped from the limit of the crane lift and in this way disburse the maximum amount of dust into the atmosphere.

If castings are shaken out at the molders floor be sure the floors are well dampened in the vicinity in which these molds are to be dumped. The dumpers usually will throw the weights and this causes more dust than the tipping of the mold if the floors are not dampened.

New Type Water Spray Adopted

The Norberg Engineering Co., Milwaukee, has developed for their own use a water spray which also uses a combination of water and air. This is adaptable in foundries where the work runs quite heavy and sand is piled in heaps before being reclaimed. This spray is made from a piece of ¾-inch gas pipe approximately 40 inches long for 90 pounds pressure. This pipe is supported by two stands or spikes approximately 6 to 10 inches high. When placed in a horizontal position the device will throw a mist over the pile of sand so when the grab bucket is dumped this spray traps considerable of the dust thus generated. While the moisture in this particular application may not trap all of the dust, it helps materially.

Supervision is one of the most important things in a dust elimination program. Diligent supervision must be secured from those employed for that purpose. The good housekeeping program, to be a success, must be sold all the way down from the top; not alone from a safety man or personnel manager's standpoint.

Sometimes it is necessary to appeal to the selfishness of an individual for his co-operation. Most supervisors must spend their time in the departments with the men for whom they are responsible. Therefore they are exposed to the same atmosphere their men create.

All of the dust created must settle somewhere. Therefore, our job resolves itself into the problem of trying to keep the foundry floor off the ceiling. If, in a year's time, enough dust is created to fill the beams and rafter to their angle of repose, a more diligent survey must be made of equipment and practice on the floor. A check of existing mechanical equipment no doubt will develop the fact in many instances small expenditures will improve conditions.

In making this survey start with existing ventilating systems, checking first, the hood opening at the source of the origin of dust. Make sure it is of proper size and design to collect effectively the dust created at the source of operation. Make sure the proper volume of air is supplied to keep (*Please turn to page* 75)

SAND CASTING COPPER-SILICON ALLOYS

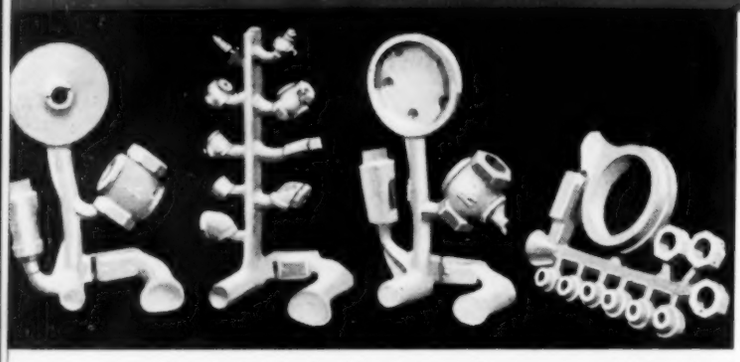


Fig. 1—Method of gating small castings with strainers and large risers

By H. A. BEDWORTH and V.P. WEAVER
American Brass Co., Waterbury, Conn.

From a paper presented before the recent Detroit convention of the American Foundrymen's Association

INCREASINGLY widespread use of copper-silicon alloys in many important fields of industry has made necessary an understanding of their casting technique in the nonferrous foundry. Metallurgists have devoted much time and study to the possibility of substituting other metals for tin in the older and better known bronzes. The copper-silicon group is an outstanding example of that development brought about by a decrease in the world's visible supply of tin and the high price of this metal.

Silicon Important As Alloy Element

The alloys are principally copper alloyed with the element silicon plus one or more additions to enhance their other properties, particularly those which render them especially suitable for the manufacture of castings. Silicon, one of the most abundant elements on the surface of the earth, occurs mainly in the form of its oxide, silica, or as a constituent of silicates. These forms more familiarly are known as sand or rock. Commercially pure silicon is reduced from these compounds.

Castings of copper-silicon alloys are specified by the U. S. navy department in its specification 46B28 and by the federal specifications board in its specification QQ-C-593, the chemical composition requirements of which are as follows:

	Per cent
Silicon	1.00-5.00
Manganese	1.50
Zinc (Maximum)	5.00
Iron (Maximum)	2.50
Tin (Maximum)	2.00
Impurities (Maximum)	0.50
Copper	Remainder

The important alloying agent is silicon which enters into solid solution with copper and hardens and strengthens it at a rate much faster than the common metals such as nickel, zinc, tin, and aluminum. The metallography of some of the alloys is described by Smith in "The Constitution of the Copper-Silicon System," *Transactions* A.I.M.E., Institute of Metals Division (1929), p. 414 and "Alpha-Phase Boundary of the Ternary System Copper-Silicon-Manganese," *Transactions* A.I.M.E., Institute of Metals division (1930), p. 164. Although a wide range of composition is permitted by the government specifications and the silicon limits are especially broad, the alloys which are supplied for foundry use contain usually from about 3.5 to 4.5 per cent silicon. Because of the great hardening power of silicon, the wider limits of government specifications would permit alloys of greatly varying physical properties and the minimum physical requirements of the specifications have therefore been set at 45,000 pounds per square

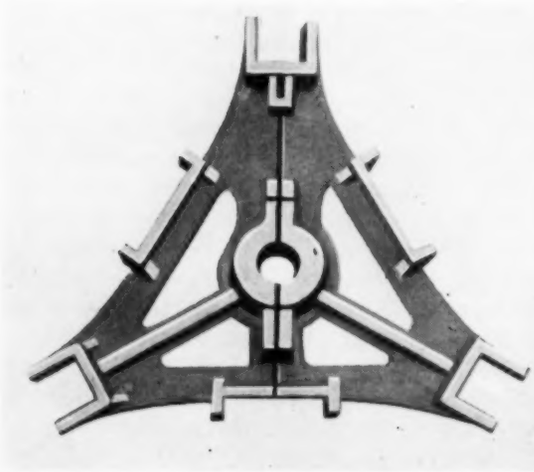


Fig. 2 (Left)—High strength is secured in this type of casting made of the copper-silicon alloy. Fig. 3 (Below)—Method of gating using the by-pass

inch tensile strength and 15 per cent elongation in 2 inches.

Development of the alloys has proceeded under patent protection and the marketing has been carried on through the use of proprietary names. The authors of the present paper have had experience principally with the nominal formula 95 per cent copper, 4 per cent silicon, 1 per cent manganese, which has been in commercial use for sand casting for the past 10 years.

Copper-silicon alloys come to the foundryman in notched ingot form ready for use and can be melted and cast with the regular equipment of brass and bronze foundries. The use of deoxidizing agents is not necessary during the melting to produce good castings.

Alloys are melted successfully in crucible furnaces, fired with anthracite coal, coke, oil, or gas or in electric furnaces. It is advantageous to maintain a neutral or slightly oxidizing atmosphere. Presence of a reducing atmosphere brought about by insufficient air supply, causing incomplete fuel combustion, results in a tendency for the alloys to absorb unburnt furnace gases which thereupon are expelled while freezing of the metal takes place. Spewing and gas porosity are almost certain to be the result.

To protect the metal during melting it usually is recommended that a layer of some gasless flux be used, such as ordinary bottle glass. While it is possible to use charcoal as a cover, it is not considered advisable because of the strong tendency of charcoal to absorb moisture and gases which, if not burned, may cause porosity in the alloy.

The alloys are melted in a quick fire and not exposed to contact with the flames any more than necessary. Molds should be prepared in advance to insure taking the metal from the furnace as soon as the proper temperature is reached and the metal should not be allowed to remain in the furnace too long after reaching the pouring temperature.

Crucibles used are of graphite or a clay-graphite mixture. Excessive stirring or puddling during the melting is to be avoided as it tends to disturb the protecting cover and may cause contamination of the metal by furnace gases.

In ordinary practice, the charge will consist of about 50 per cent new ingot and 50 per cent remelt in the form of gates, risers, etc. With the correct melting conditions and use of some ingot with each charge, it is not necessary to replenish the constituents of the alloys by additions of alloying elements. The ingot metal is charged first, together with enough glass for the cover and after this is melted down the scrap is added. Foundry scrap should be reasonably free from dirt and molding sand. Care is taken that scrap is not allowed to be exposed to the furnace flame and then permitted to melt and trickle down through harmful gases. Such a procedure will cause absorption of reducing gases if these are present or, on the other hand, excessive oxidation and loss of metal if an oxidizing atmosphere exists.

Fig. 5—Kettle weighing 3440 pounds cast of copper-silicon alloy

Machine shop scrap in the form of turnings, borings, shavings, etc., can be used successfully in the charge. That type of scrap should be kept dry and, preferably, free from oil or similar cutting compounds. Because of the high ratio of surface to volume in such scrap, oxidation and gas absorption must be kept at a minimum by melting down the material at a low temperature in a bath of molten metal.

Contamination of the charge by other foundry alloys is to be avoided by maintaining a close control over scrap handling and setting aside the required melting equipment such as crucibles or furnaces for such alloys to prevent trouble.

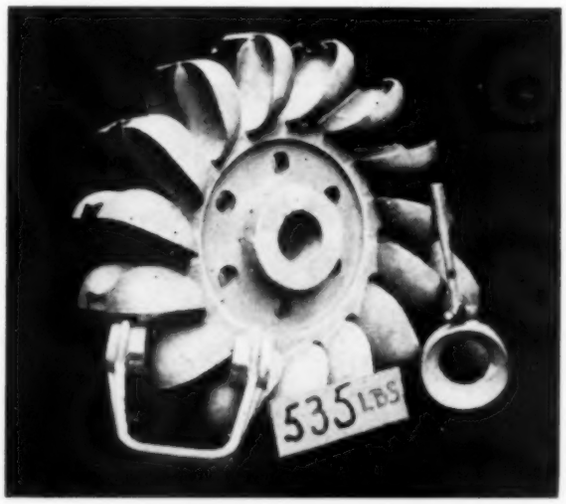


Fig. 4—Water wheel cast of the copper-silicon alloy

Fig. 6—Sixteen-inch gate valve weighing 2000 pounds

Copper-silicon alloys are a very fluid and searching type of metal which makes it possible to run small castings of thin sections producing sharp and well defined outlines. The molding in general would follow quite closely the practice for gun metal.

For these alloys, a fairly open sand will give the best results. The wide variety of castings for which the alloys have been used makes it rather impractical to suggest any one sand for all purposes. Sand of about No. 0 Albany grade is used successfully for lighter sectioned castings and No. 1 or 2 Albany is used for heavier sectioned castings. Moisture content should not be more than 5 or 6 per cent. For best results, particularly on heavier sectioned castings, baked molds are used.

Cores should be made from an open, sharp sand with, preferably, linseed oil for a binder. The ratio of sand to oil is about 60 or 70 of sand to 1 of oil and should be high enough to give an open and fairly soft core. Baking should be at 350 to 500 degrees Fahr. for at least several hours and the cores may then be given a wash.

Light Ramming Improves Permeability

Molds should not be hard-rammed close to the pattern but in the body of the mold away from the pattern the ramming can be somewhat harder. Permeability of the sand is improved by light ramming; it is also desirable that every chance be given the sand to contract to counteract hot-shortness during freezing and so lessen the danger of shrinkage cracks. There should also be vents to aid the escape of gases.

Although there are a number of fundamental principles to be observed in gating, probably the most important is that every pattern is a problem in itself and should be treated as such. In general, the metal should enter the mold cavity near the bottom and with the least amount of splashing and turbulence. Gates preferably are placed at the heavier sections where it is possible to use feeding risers which will contain the hottest metal when pouring has been completed.

For some castings, a good method is to pour through a strainer gate that can be choked quickly. The runner leading from the strainer should be cut considerably larger than the combined area of the holes in the strainer to reduce the pressure between the strainer and the casting. Fig. 1 illustrates the application of strainer gates for small castings. It will be noted that runners are made quite large and therefore act as feeders during freezing.

Some foundrymen prefer to use a by-pass and runner for pouring the copper-silicon alloys. The by-pass is placed in the drag of the mold and is cut deeper than the runner. The runner may be placed entirely in the cope or at the parting of the flask, half in the drag and half in the cope. The by-pass checks the velocity of the metal, and being cut deep, acts as a strainer, insuring clean metal entering the runner. Branch runners from the main runner to the patterns are cut either at right angles or staggered back. This acts as a further check to the velocity of the metal and assures its flowing into the mold with the least possible disturbance. Fig. 3 illustrates the by-pass method.

Copper-silicon alloys have a moderately high shrinkage and have a freezing range that causes shrinkage of the interdendritic type. This results from the first metal to freeze sending out fingers or dendrites of high melting point constituent and around these dendrites the last metal to freeze then leaves voids unless precautions are taken to feed the heavier sections with sufficient molten metal.

Risers Located Near Gates

Freezing should take place progressively from the thinner sections toward the heavier sections which in turn should be fed with risers located as close to the section to be fed as is practicable. As mentioned before, feeding risers, if possible, should be located near the gates so that they may get the benefit of hot and fluid metal which has not been chilled in passing through the mold cavity. Risers should be of sufficiently large cross section so that the riser is the last metal to freeze. The height of the riser is not so important; in fact, blind risers extending only partly up through the cope are used to good advantage if they are of correct cross section.

For securing sound castings, particularly fittings which must be leak-proof, it also is well to make use of as much hydrostatic pressure of molten metal as (*Please turn to page* 59)

Table 1

Approximate Properties Copper-Silicon Alloy

Melting Point	1832 degrees Fahr. (1000 degrees Cent.)
Specific Gravity	8.15
Weight (lbs. per cu. in.)	0.294
Pattern Maker's Shrinkage (in. per ft.)	3/16
Thermal Conductivity at 20 degrees Cent. (cal./sq. cm./cm./sec./degrees Cent.)	0.06
Electrical Conductivity at 20 degrees Cent. (per cent I.A.C.S.)	4.9
Brinell Hardness No. (10 mm. ball, 500 Kg. load)	80
Tensile Strength (lb. per sq. in.)	50,000
Yield Point (lb. per sq. in.) (at 0.75 per cent extension under stress)	20,000
Elongation (per cent in 2 in.)	20
Reduction in area (per cent)	25
Modulus of elasticity in tension (lb. per sq. in.)	15,000,000

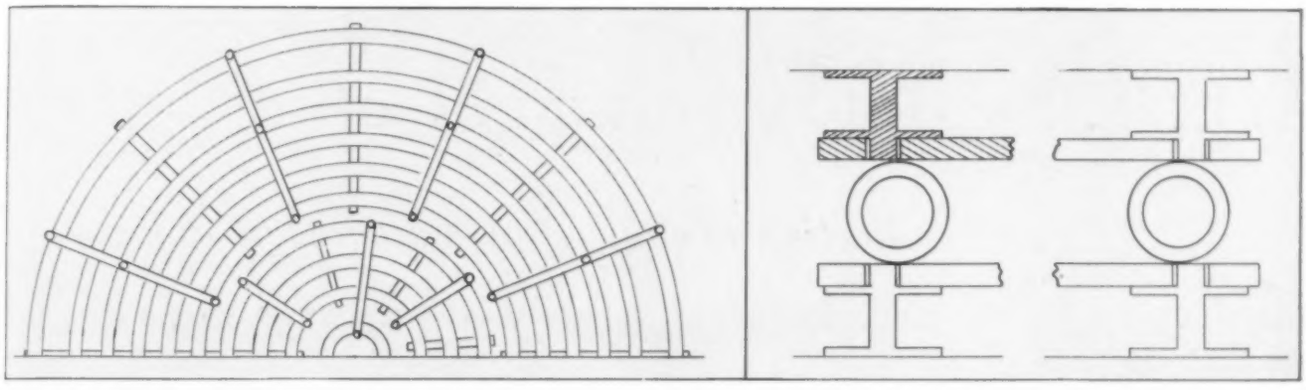


Fig. 1 (Left)—General arrangement of bottom coil, steel strips and chaplets. Fig. 2 (Right)—Coils supported on strips of metal

STEEL COILS ARE CAST IN IRON POT

A PROBLEM rather out of the ordinary confronts the foundryman who for the first time is faced with the production of a casting in which a length or a coil of steel or wrought iron pipe is to be enclosed. He knows the pipe will expand with the heat. If it is not held firmly it will float. If the metal remains liquid for a considerable period, the pipe may become soft enough to collapse, and finally he is afraid that the pipe may melt. Unless he is familiar with the subject through actual practice he will overlook the fact that a thin coating of oxide on the pipe will cause the molten metal to boil violently in the vicinity with the consequent formation of blowholes or gas cavities in the casting. In many instances foundrymen adopt precautionary measures to prevent the pipe from melting or collapsing. Where conditions are favorable a length of hose is attached to both projecting ends of the pipe and a stream of water is kept flowing through the coil. In other instances the pipe is filled with dry sharp sand. Where water is used it must be started flowing before any metal enters the mold. If the stream of water is started after the pipe becomes heated, the water is converted to steam and the pressure will prevent any further water from entering the pipe. The hose connection will be wrenched loose and any person in the vicinity is in danger of being scalded with steam and boiling water.

Introduce Metal From Top of Mold

Except in extreme and exceptional instances neither water nor sand is required in the pipe coil. The pipe acts as a chill and the molten metal in immediate contact forms a protective sheath. In fact in the majority of instances the problem resolves itself into introducing the metal rapidly enough to prevent coldshuts in the casting. For that reason it is advisable to introduce the metal from the top of the mold rather than from the bottom or at any intermediate point. Also care must be taken that the direct metal stream from the gate does not play directly on the pipe. A continued stream of fresh, hot metal flowing directly on the pipe will melt a hole through it. By pouring metal through the top of the mold, the metal in the bottom of the mold remains stationary and is not constantly replaced with hot metal, as is the case where the casting is gated at the bottom.

Adopting Anchorage Method Important

One of the perplexing features of the general problem is the erratic behavior of the pipe when surrounded by molten metal. It simply has to expand and the direction of this expansion may be up, down, or sideways, depending on several factors, including the manner in which the pipe is supported in the mold. If the supports are too far apart the pipe will bend between any two. Usually it will bend upward, but instances are not unknown of the pipe bending in the opposite direction. Where the pipe actually *cuts through* the top or bottom of the casting, it may be sufficient cause for condemning the casting. In other instances, the pipe may bend, but because it does not show on the surface of the casting, the foundryman assumes that it is in the original position in the center, when in reality it may be far to one side. Under certain conditions, this may not constitute a vital defect, while in others it seriously may affect the life of the casting. Summing the situation up generally it may be said that the problem of enclosing a pipe in a casting is not to find a way to prevent the metal from entering the coil but to adopt an anchorage method that will prevent the pipe from wiggling out of place.

Consider a typical instance, a cast iron pot 5 feet diameter, 30 inches deep, 2¾-inch side wall thickness and 3½ inches thick on the bottom. The pot has two coils cast in, one in the bottom and one in the side (*Please turn to page* 60)

A. S. T. M. Holds Annual Meeting

Collection of papers on radiography and x-ray diffraction methods features technical program

VIEWING the highly successful and well attended thirty-ninth annual meeting of the American Society for Testing Materials, held in Atlantic City, June 30 to July 3, little of immediate value to the foundry industry is apparent. No papers pertaining specifically to the manufacture of gray iron, steel, malleable, or nonferrous casting or relating to their properties appeared.

However, this meeting was significant for the attention devoted to technical means of testing, analyzing and inspecting materials, many of which are of prime importance to the foundry industry.

Important Studies Are Under Way

The four sessions devoted to a symposium on radiography and x-ray diffraction methods bear directly upon a means of testing that is still uncertain and indefinite but which forms the basis for acceptance or rejection of castings, particularly those purchased and used by government departments and a few large interests in the oil production and refining, railroad and power equipment industries.

The study of effects of corrosion, the development of long time creep tests and some new discoveries on the subject of impact testing at high velocity have a bearing upon foundry production, but probably many years ahead. Discussion of analytical methods, reports upon various committee activities affecting foundry products, and, more important, the work of these committees during the convention bear directly upon the foundry industry at the present time.

Accepting the statement that a few thousand people are sufficient at any time to change the thinking of America, Harvey S. Vassar, Public Service Electric & Gas Co., Irvington, N. J., in the annual address of the retiring president urged active participation of the several hundred scientific associations in solving social and economic problems, at the opening session of the thirty-ninth annual meeting. Citing the historic comment of King Edward VIII on his visit to the QUEEN MARY, in March this year, when he observed, "How do you reconcile a world that has produced this mighty ship with the slums we have just visited," Mr. Vassar warned of the power of tradition and other influences to give the mind a permanent set and distort judgment on public affairs. He asked for the scientific approach, the search for facts and the determination of a meeting ground of contrary opinions instead of controversy and the warfare of present day discussion of problems of government, finance, security, labor and the related subjects. Unemployment is capable of solution if divested of prejudice, sentiment and rancour.

The report of the executive committee, submitted by C. L. Warwick, secretary-treasurer, noted an increase of 129 in membership, marked improvement in income, some of which reflects a wider purchase and use of publications and a marked increase in effective committee work. District and group meetings, many in co-operation with other associations, are other functions of the society which are prospering.

Outlines Chemical Engineering Progress

H. C. Parmelee, editor, *Engineering & Mining Journal*, New York, outlined new developments in chemical engineering which have reached the stage of requiring attention from the testing organization. These include the three types of plastics; carbon in various forms and the detergents, which are derivatives of alcohols termed soapless soaps, used in industrial cleaning applications. The speaker also touched on new alloys of lead which are work hardened, and silver used in the pure state.

Four sessions of the annual meeting were devoted to a symposium on "Radiography and X-Ray Diffraction Methods" developed by subcommittee VI on x-ray methods of committee E-4 on metallography. H. H. Lester, Watertown Arsenal, was chairman of the first session on Tuesday, with R. H. Aborn, W. C. Hamilton and C. A. Adams as co-chairmen.

A discussion of some of the basic principles underlying the radiographic process was presented in the first paper by John T. Norton, Massachusetts Institute of Technology, Cambridge, Mass. Mr. Norton pointed out that an important part of the radiographic equipment is the detecting device, consist- (*Please turn to page* 64)

Section of the Romance of Iron and Steel exhibit showing several murals and the foundry floor

GREAT LAKES EXPOSITION FEATURES ROMANCE OF IRON AND STEEL

CONCEIVED as a tribute to the material, social and cultural progress achieved by the Great Lakes region during the last century, and dedicated to the industries of the Great Lakes states, namely Ohio, Indiana, Illinois, Wisconsin, Minnesota, Michigan, Pennsylvania and New York, the Great Lakes Exposition was opened formally at Cleveland on June 27 and will continue through Oct. 4.

This large exposition which now is entertaining visitors from every part of the country, is located on the shore of Lake Erie and celebrates the 100th anniversary of the incorporation of the city in a most fitting and interesting manner. Cleveland's beautiful Public Hall, the large underground exhibition hall, and many new buildings built for the occasion along the lake front, house interesting and instructive exhibits which should have an exceptionally wide appeal. Several views of interesting features of the exposition are reproduced in this issue of THE FOUNDRY.

Entrance of exhibition at night. Illustration courtesy of Westinghouse

The romance of iron and steel is the theme of a large exhibit in the Lakeside underground exhibition hall which is sponsored by the nation's greatest steel companies and was developed by Dr. A. A. Bates, Case School of Applied Science, Cleveland; Myron S. Curtis, Youngstown Sheet & Tube Co., and J. T. Dickson, of the exposition.

Starting with an actual size reproduction of a Minnesota mine shaft, the exhibit shows a large relief map depicting the importance of iron, steel and coal commerce on the Great Lakes, an old style forge with bellows, a cast house of a blast furnace, a model of a 2-high blooming mill and a galvanizing mill, a replica of a 125-ton ladle, and many murals showing various processes in steel making. One mural shows a pouring scene in a foundry, and one corner of the display has been (*Please turn to page 72*)

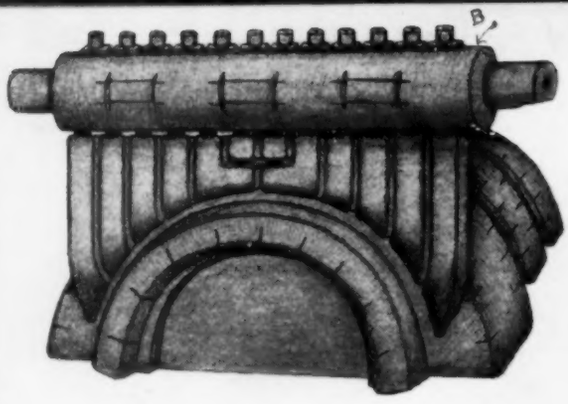


Fig. 20

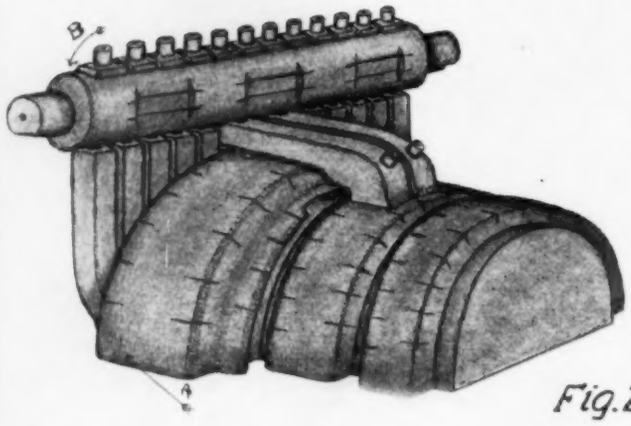


Fig. 21

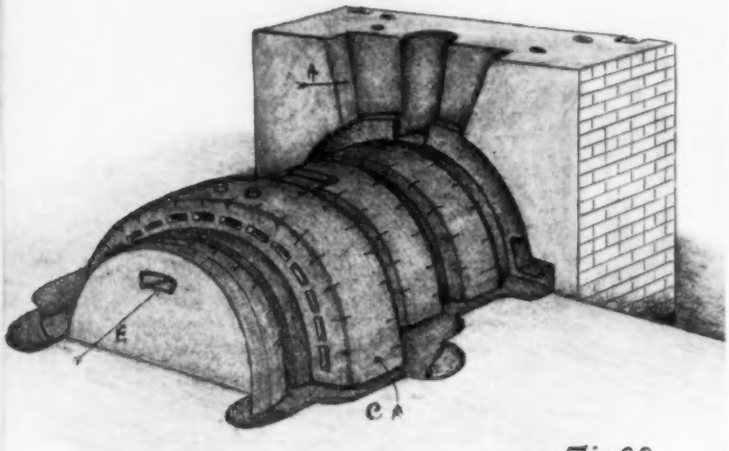


Fig. 22

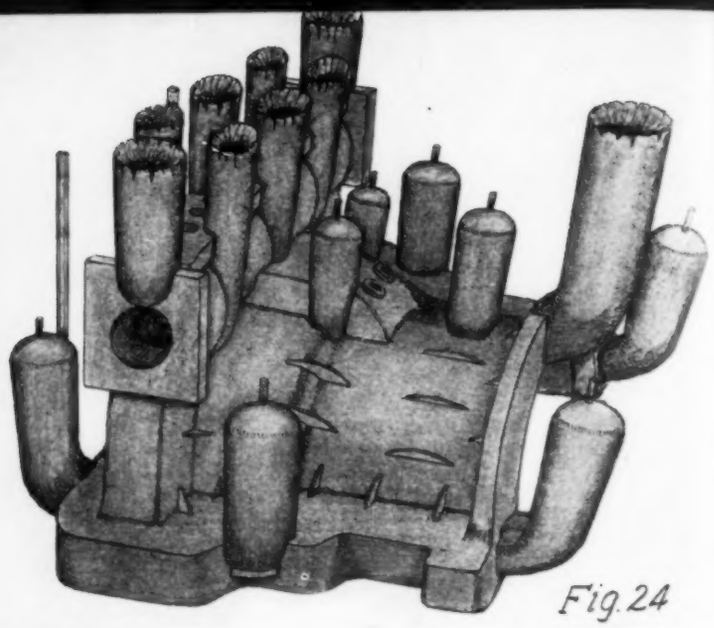


Fig. 24

MOLDING STEEL

Part II

INTERESTING features covering the methods pursued in making the mold and cores for a large steel turbine casing in a prominent British foundry were presented in the June issue of THE FOUNDRY. The present description covers the subsequent operations in closing the mold, pouring the metal, stripping and annealing the casting. Alternative methods also are presented for molding the casting in the opposite or joint up position.

Core assembly and bracketing arrangement are shown in Figs. 20 and 21. The large end drawback and body cores are shown assembled in their permanent position in Fig. 22. Before proceeding further with the assembly these are checked over with gage and length templets. Particular care is taken to ensure machining allowances sufficient to meet machine shop requirements on the various surfaces of the casting.

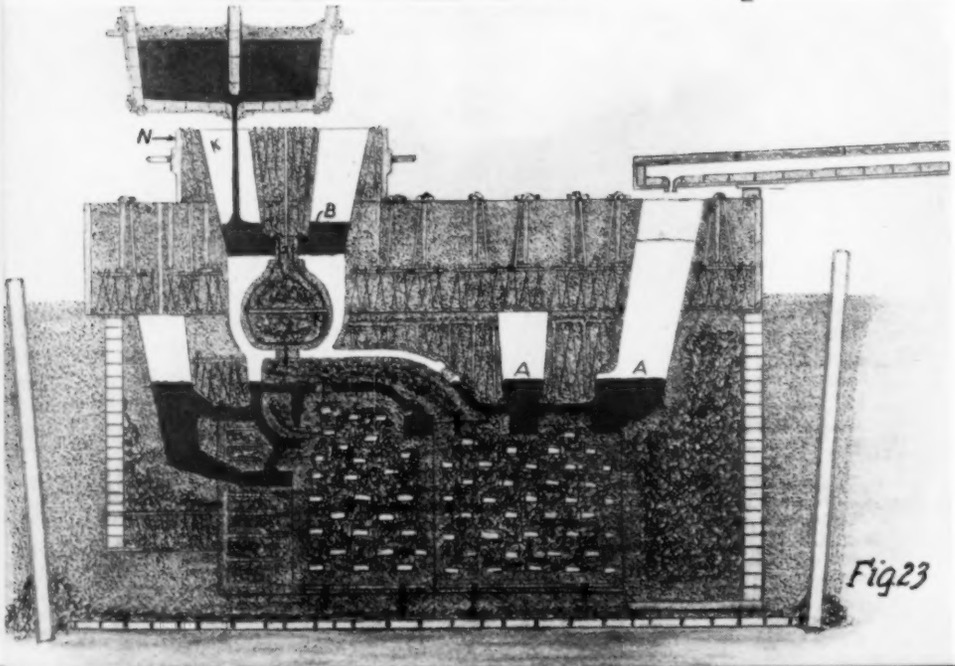


Fig. 23

Fig. 20—Set of assembled cores showing brackets. Fig. 21—View from opposite end. Fig. 22—Mold with first end drawback in place. Fig. 23—Showing metal at different levels during pouring operation. Fig. 24—The casting showing distribution and style of feeding heads. Fig. 25—Main core divided into four sections. Fig. 26—Casing molded in flange up position. Fig. 27—Sectional view through steam chest and ports. Fig. 28—Plan view showing location of runners and risers. Fig. 29—Sectional view of third type of casing

Fig.25

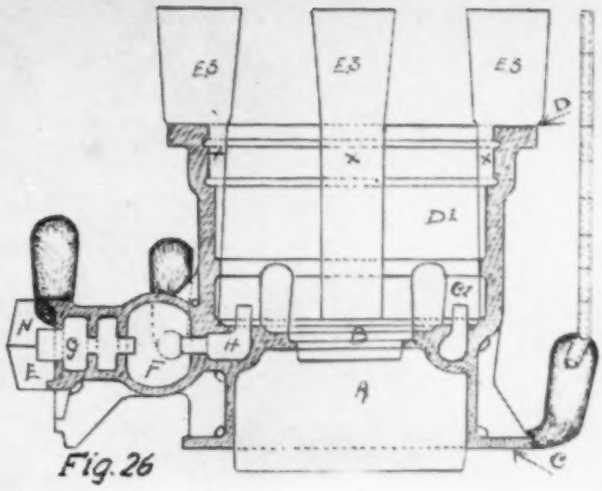


Fig.26

TURBINE CASINGS

By H. V. FELL

The two side drawbacks next are placed in their respective positions, after which the nozzle port cores are assembled and secured. Adequate vents carefully protected are essential. Outside edges of the core prints are smeared with a layer of specially prepared loam to prevent the molten steel from oozing into the vent openings. Chaplets in some instances constitute a source of trouble in castings subjected to high liquid or gas pressure. Hence the number of these devices is held to a minimum.

After the cores have been placed and secured, the remaining end drawback *B*, Fig. 7 is lowered into place. Up to this stage the molder has had a clear view of the desired metal thicknesses, etc. From this stage onward this is not possible. He has to adopt another method to give him the desired information. Small wads of soft clay are placed on the surface of the mold immediately below the respective positions of the parts which are to be lowered into position. Thus after the top drawback Fig. 13 has been lowered into place, it is lifted again and the thickness of the flattened clay wads is measured. If this thickness is as it should be, the drawback is lowered into place permanently.

Similar precautions are observed in setting the top chamber core *B*, Figs. 20 and 21. This core is adjusted in a manner that will bring the port openings in perfect alignment with those below.

Pieces of Plate Set on Joint

To prevent a possible crush in trying on the cope, small ½-inch pieces of plate are placed on the joint. Where the clay wads show that clearance on the prints is sufficient and that the space for the metal is correct, the cope is replaced permanently and fastened down by a number of long bolts attached to strong steel bars or binders below the mold bed.

Vent pipes are set up at various points outside the walls of the mold to facilitate the escape of gases

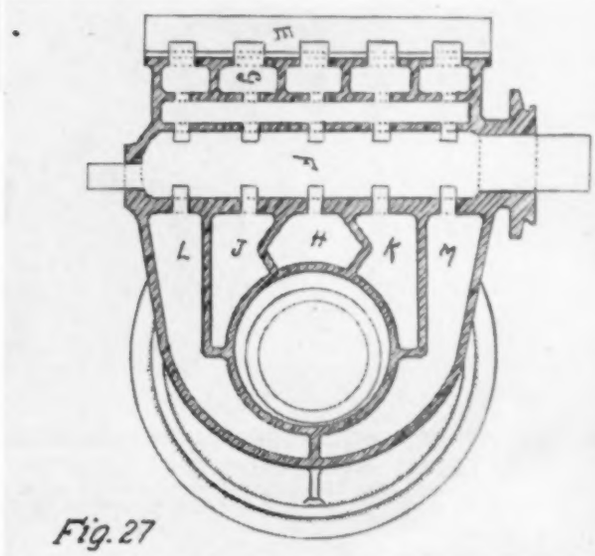


Fig.27

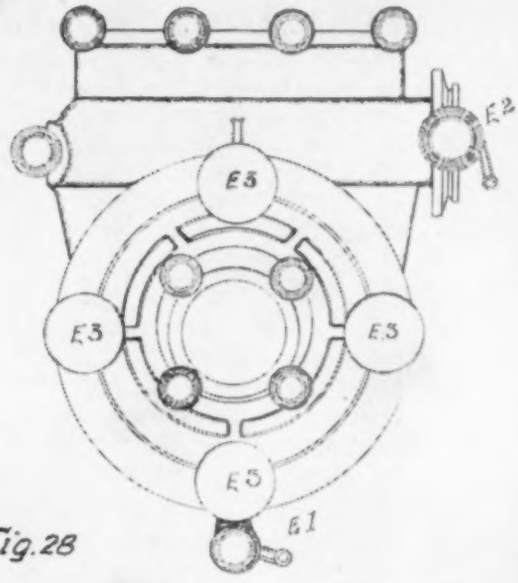


Fig.28

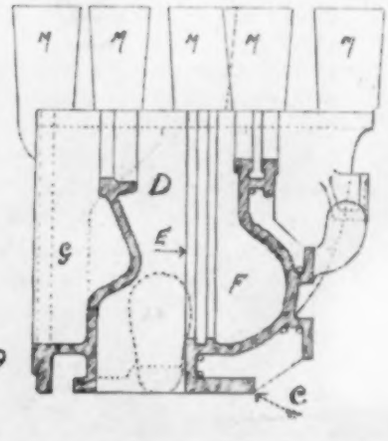


Fig.29

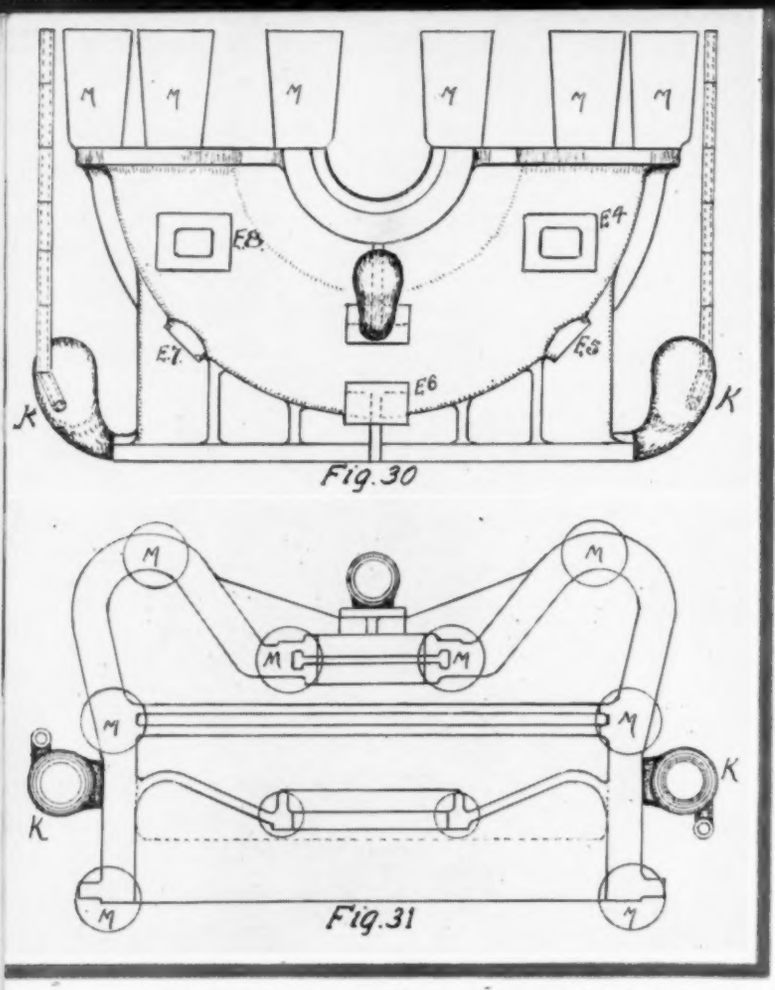


Fig. 30—Showing distribution of sprues, heads and external chills. Fig. 31—Plan view of third casing showing gating and feeding arrangement

generated during the pouring process. Sand then is rammed firmly in the space between the mold walls and the walls of the pit. The head box *N*, Fig. 23 and the runner boxes are placed in position on top of the cope. The runner boxes are set to coincide with the two nozzle centers on the ladle. Operation of assembling the mold is completed by placing suitable bars and weights on the cope.

A total of 36 tons of steel is required to pour this casting. Realizing the necessity of maintaining a uniform heat gradient throughout the casting the metal is poured in three stages and from separate furnaces. This involves a careful timing program. Ultimate success depends greatly on carrying out this arrangement carefully.

No. 1 ladle containing 25 tons of steel is provided with two 1¾-inch nozzles which are opened simultaneously. A second single nozzle ladle containing 10 tons of steel is placed in position for pouring into a runner leading to the head as shown to the upper right in Fig. 23. The second ladle nozzle is not opened until approximately 18 tons of steel from No. 1 ladle has flowed into the mold and has risen to the level *A*, Fig. 23. One nozzle in No. 1 ladle then is closed while metal continues to flow from the second ladle. A few moments later the remaining stream from No. 1 ladle is shut off and the ladle is moved over the head *K*, Fig. 23. By this time the metal in the mold has risen to the level *B*, Fig. 23. Steel from No. 1 ladle then brings the metal to the top of the heads. After allowing a short period for the metal to settle in the heads, a third ladle containing about 1 ton of fresh, hot steel is used to fill the various heads.

After the metal has set, weights are removed from the cope, bolts are released and sand is removed from the vicinity of the heads to allow freedom of contraction. Later the cope is removed and heavy portions of the casting stripped to promote a more uniform cooling rate between various sections. The casting is given a rough cleaning in the pit before it is lifted and removed to the cleaning department. At this stage it appears as shown in Fig. 24.

Heads and brackets are removed with an acetylene torch and then the casting is given a double heat treatment. In the first it is heated to between 880 and 890 degrees Cent. (1616-1634 degrees Fahr.) In the second treatment the casting is raised to a temperature of 770 degrees Cent. (1418 degrees Fahr.), held for a period at 600 degrees Cent. (1112 degrees Fahr.) and then cooled slowly. The surface then is cleaned thoroughly after which the casting is inspected closely before delivery to the machine shop.

Alternative methods for molding turbine casings are shown in Figs. 26 and 29. The first method illustrates how effective results may be obtained through the addition of internal feeding strips. The gross weight of this casting is 12 tons. The mold is made in a flask. On account of the design in this instance the casting is molded with the main flange joint on top. Sectional views of the casting are shown in Figs. 26 and 27. A plan view is shown in Fig. 28. To facilitate the molding process parting joints are made at *C* and *D*, Fig. 26. The part over the steam chest is lifted away as a drawback. For convenience the main center core is divided into four sections, *A*, *B*, *C*1, and *D*1, Fig. 26. This division gives the molder more freedom in assembling these sections over the port cores. Also the weight of the large section *D*1 is supported through the pedestal section *B* on section *A* base core. This prevents any hazard of a crush on the port cores. The port cores *H* are supported temporarily on chaplets, which are removed after the cores have been suspended by suitable hooks from the section *C* core as shown at *E*, Fig. 25. Further, this method insures a clear vent passage from the port cores to the center.

Cores are placed in the mold in the following order: First *A* and *B*, then *E*, followed by *F* and *G*, and these in turn by the port cores *H*, *J*, *K*, *L*, *M*, Figs 25 and 27. The assembly is completed by cores *N* *C*1 and *D*1, Fig. 26.

Steel for this casting is poured through two 1¾-inch nozzles. In the beginning the steel from one nozzle flows (*Please turn to page* 72)

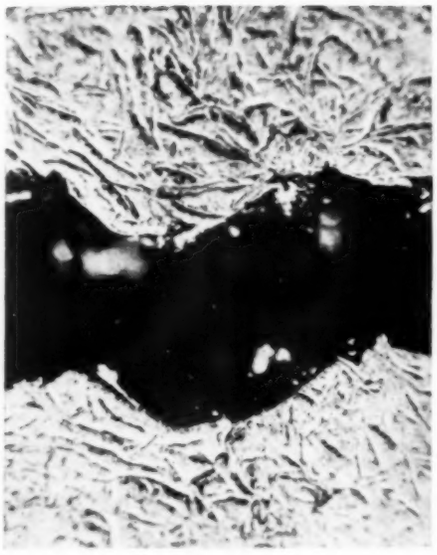


Fig. 107—Path of fracture, 25 diameters, unetched

GRAY CAST IRON

By JOHN W. BOLTON

Chapter X

General Engineering Properties

SOME of the general engineering properties of gray iron and the general relationships of these to structure and composition are discussed in this chapter. The term gray iron is applied to a series of alloys within which may be found great differences in properties from one part of the series to another.

Uses of gray iron castings can be classed as artistic and utilitarian. The fluidity of cast iron and its expansion after solidification allow it to be cast readily into intricate shapes with excellent delineation of detail. Thus it is well adapted indeed to certain types of art castings. However, most of its applications are utilitarian, as it is a most useful, reliable and economic material for many applications in engineering design.

Speaking broadly, uses of alloys such as gray iron are mechanical, or chemical or both. Gray iron castings have been used for many years and extensive experience has been obtained on their performance in service. In general the service realized has been satisfactory. In relatively few instances failures in service have been experienced. Usually such failures have been due to improper selection of classes or grades of gray iron or to attempts to use gray iron when more suitable materials were available.

Within the last 15 years great advances have been made in the manufacture of gray iron, both in production of higher strength and tougher irons, and in attaining greater uniformity in known classes. To this we may add that wider knowledge has been gained of the real potentialities of gray iron which insures more intelligent application. For a certain period many iron castings were supplanted by other materials and in some cases this displacement was warranted.

However, recent developments and wider dissemination of knowledge leads the author to the opinion that there is a new trend toward wider utilization of gray iron. The pendulum may continue to swing toward one side or another, but gray iron will continue to occupy a responsible position in the world of alloys.

Gray iron is relatively easy to cast sound and possesses a wide range of physical properties. It may be cast to close dimensional tolerances. It is relatively low in cost due to the combination of inexpensive raw materials, highly efficient melting processes, lack of need for elaborate precautions in molding practice as compared to some

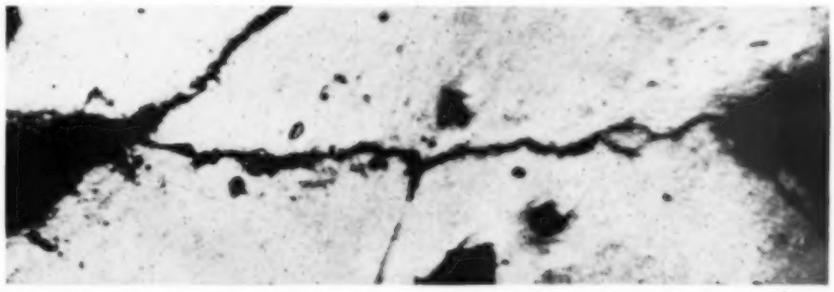


Fig. 108—Fine hairline crack extending between two graphite flakes, 1000 diameters, unetched

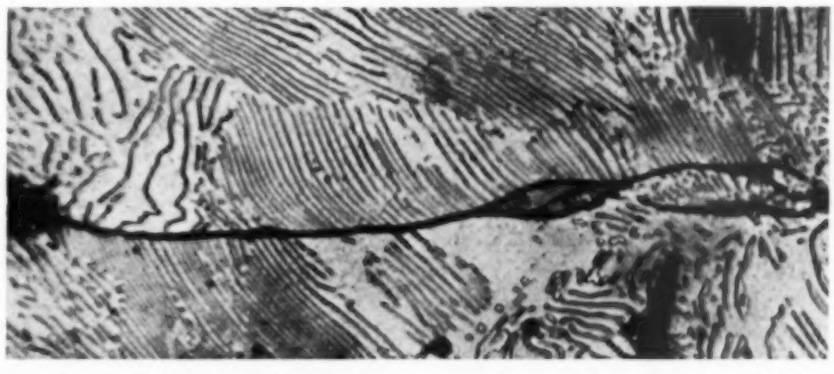


Fig. 109 — Hairline crack follows along pearlite grain boundaries, 1000 diameters, etched

Fig. 110 — Fracture through steadite crystals, 500 diameters, etched

other alloys, high yield, low cleaning costs, good machining properties and usually low foundry and shop losses.

Strength of gray irons can be controlled rather closely and tensile strength classes from about 20,000 pounds per square inch to well over 60,000 pounds per square inch are available. In some of the very special irons, including the so-called semi-malleables, or as they are more properly termed, pearlitic malleable cast irons, tensile strengths up to 120,000 pounds per square inch have been attained. As a rule, the relative rigidity is rather closely proportional to tensile strength, ranging from relative elastic moduli in tension of about 12,000,000 for the lower tensile classes to well above 20,000,000 for the special irons.

There is no well defined elastic limit, as cast iron under stress exhibits both elastic and plastic deformation simultaneously as will be described in detail in the section on strength, to appear later. However, tests at room temperature have shown that gray iron can sustain continued loadings up to 80 per cent of its ultimate strength

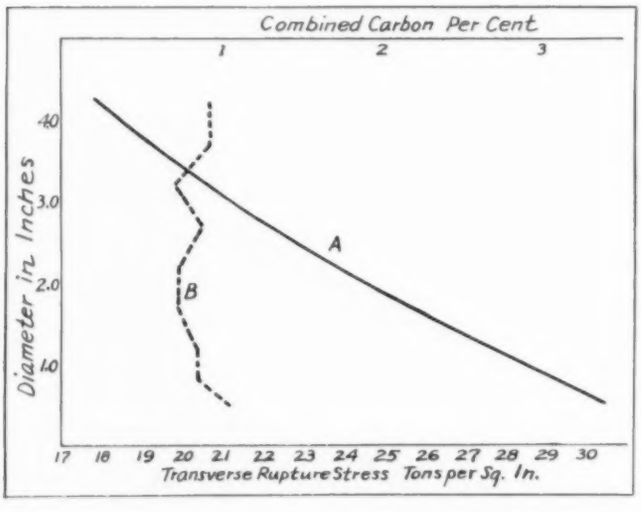


Fig. 111 — Effect of difference in section with constant carbon

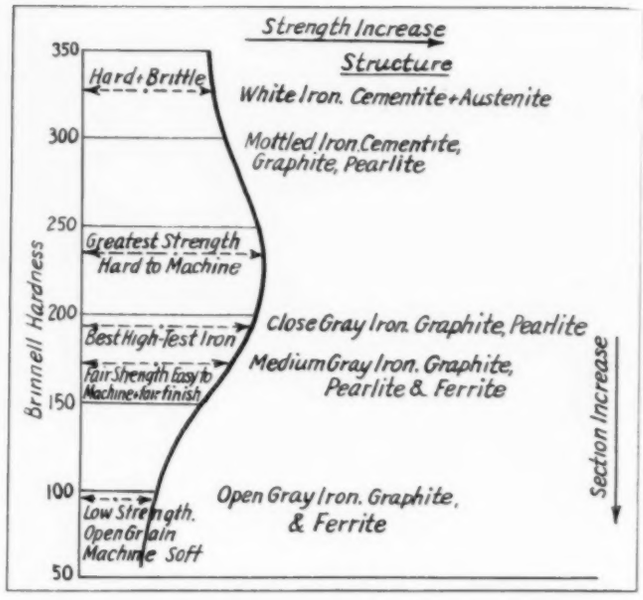


Fig. 112—General relationship of strength to structure

which is a higher percentage than obtains in most cast alloys. True gray irons exhibit little real ductility, although some of the semi-malleables have elongations of 8 per cent or more.

Strength of gray iron in compression often is about four times the strength in tension. The transverse test, as commonly used, measures the relative strengths and deflections of irons in given test bar sizes. Due to the different strengths of gray iron in tension and compression the modulus of rupture (theoretical ultimate fiber tension stress) calculated from the transverse breaking load is higher than the actual tensile strength for the same section as shown in Table XIII, and reasons for that will be discussed in the section on transverse properties, to appear later.

These strength properties are closely related to the structure of the metal. As has been shown cast iron consists of a matrix throughout which are dispersed many non-tenacious graphite flakes. Obviously, strength depends on the properties of the matrix and the degree to which these properties are affected by the graphite flakes. Fig. 107, 25 (*Please turn to page* 80)

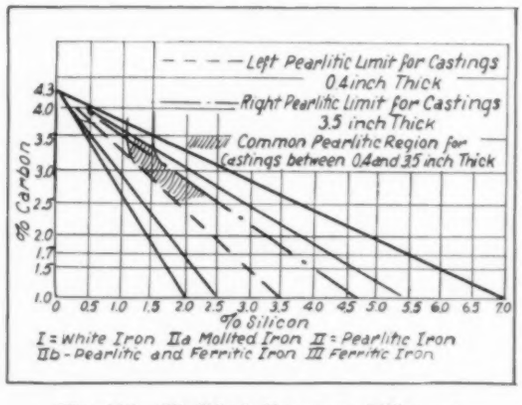
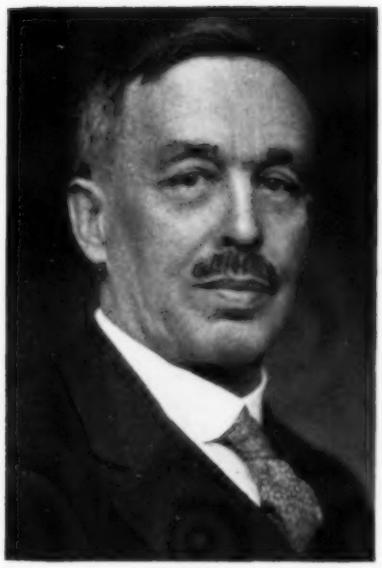

Left Pearlitic Limit for Castings 0.4 inch Thick
Right Pearlitic Limit for Castings 3.5 inch Thick
Common Pearlitic Region for Castings between 0.4 and 3.5 inch Thick
% Carbon
4.3
4.0
3.5
3.0
2.5
2.0
1.7
1.5
1.0
0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0
% Silicon
I = White Iron IIa Mottled Iron II = Pearlitic Iron
IIb - Pearlitic and Ferritic Iron III Ferritic Iron

Fig. 113—Modified diagram of Maurer

C. W. Bigg
Senior Vice President



H. Winterton
President

J. Hepworth
Junior Vice President

I. B. F. Holds Meeting in Glasgow

By VINCENT DELPORT
European Manager, The Foundry

AFTER a lapse of eleven years the annual convention of the Institute of British Foundrymen again was held in Scotland. This year, the thirty-third annual conference took place in Glasgow, thus inaugurating the presidency of H. Winterton, Wm. Cumming & Co., Ltd., Kelvinvale Mills, Maryhill, Glasgow.

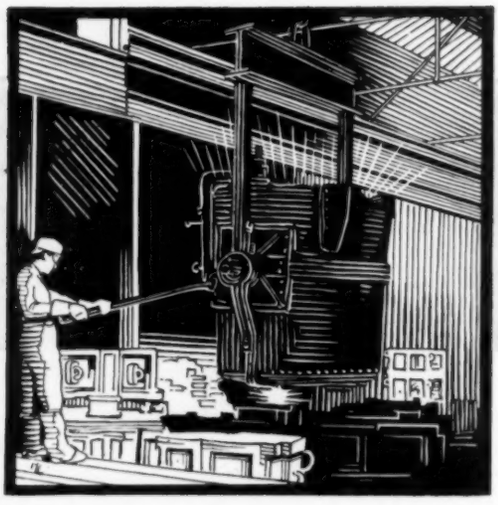
Much water has run down the Clyde during the interval of eleven years, and the conditions under which this year's congress were held were much more favorable to the foundry industry than in 1925. In that year, when the members attending the convention took part in the classical trip down the river Clyde, most of the shipyards that border both sides of the river were silent. This year, the waterway resounded with the noise of riveting hammers, the city of Glasgow and the surrounding industrial districts were teeming with activity, and visitors could notice the smiling countenances of their Scottish hosts, who extended their proverbial hospitality to the members of the Institute, who came from the four corners of the British Isles and from overseas.

Proceedings of the conference opened on Tuesday, June 9, with the annual general meeting of the members of the Institute, which was held at 6 p.m., with J. E. Hurst, president, in the chair. The report of the council and the balance sheet were presented to the meeting. The membership roll as of April 30, 1936, numbered 1892 members of all grades, compared with 1780 a year ago, showing an increase of 112 members for the year. The report of the technical committee also was presented.

Award of the Oliver Stubbs gold medal was then announced. Two recipients selected for this year were E. Longden, Manchester, who visited Detroit at the time of the international congress in 1926, and F. Hudson, Glenfield & Kennedy, Ltd., Kilmarnock, Scotland, who is also well known in the United States. Both recipients were awarded the medal for their valuable contributions to foundry knowledge by way of research work and published papers.

Election of officers for the year 1936-37 followed, and Harry Winterton, who also visited America in 1926, was unanimously elected president. The names of the other officers who were installed in office are given in the accompanying box. In addition, two honorary life members were elected unanimously: Prof. Albert Portevin, Ecole Centrale des Arts et Manufactures, High School of Foundry, High School of Welding, etc., Paris, and Dr. Percy Longmuir, 2, Queen's Road, Sheffield, one of the original members and a past-president of the Institute of British Foundrymen. Following the annual meeting of members, there was a reception in the City Chambers of Glasgow by the Rt. Hon. the Lord Provost, magistrates and councilors of the City.

On Wednesday, June 10, the conference opened, in the Rankine Hall of the Institution of Engineers and Shipbuilders in Scotland, with an address of wel- (*Please turn to page* 76)



Questions and Answers

This department includes problems relating to metallurgical, melting and molding practice encountered in making castings. Questions from subscribers addressed to the Editor of The Foundry will be answered by members of the editorial staff, supplemented where occasion requires by the advisory staff.

Exposure to Heat May Cause Silica Coating to Fall From Surface

Recently we cast a steel slab 4 x 4 feet, and 4 inches thick in an inclined mold. In machining the casting, dirty areas were found on the cope side, where apparently the silica coating had dropped from the face of the mold and became imbedded in the metal. This is the usual grade of silica flour mixed with molasses water and applied in the usual manner. Is this practice and this type of trouble found in American steel foundries?

Probably every steel foundryman in America or elsewhere has had experience with that form of trouble at one time or another, particularly on castings where a large area of the cope is exposed for a considerable time to the heat from the rising metal. In a thick coating the binding agent burns out and the silica falls in flakes or dust. A partial remedial measure is to apply only a thin coating of the material to the face of the mold. However, in this connection it may be pertinent to refer to a few other factors which singly or in combination cause the silica coating to fall from the sand face of the mold or core.

If the sand is slicked excessively with the tools, the glazed surface will form a parting from which the dried silica easily is detached. Tight sand, that is sand excessively high in bonding material, will cause the same trouble. Too much molasses or other binder in the wash will form blisters which fall off when the metal strikes them. In some instances the addition of bentonite to the wash prevents it from flaking or dropping. The clay seems to give it a better grip. Some steel foundrymen mix the silica flour with diluted core oil instead of the usual molasses water. In some instances the surface of the mold is sprayed lightly with the core oil before the wash is applied. Some time ago a prominent manufacturer of foundry facings introduced a silica wash that is gaining wide acceptance. It is mixed in the shop with plain water. It is considerably higher in price than the ordinary grades of silica flour, but it is claimed that the extra cost is more than offset by the savings effected in the cleaning room.

Determining Size of Pattern To Secure Given Casting Weight

We shall appreciate your advice on how to make post mauls 16 and 20 pounds in weight.

Since the construction of the pattern and mold for one of these hammers or mauls represents elementary foundry practice, we assume your question refers to the method of determining the size of the pattern to secure a casting of a given weight. A plain cylindrical iron casting 4 inches in diameter will weigh 3.30 pounds per inch in height. Thus a hammer 6 inches in height or length will weigh 19.80 pounds. A hole for the handle 2 inches diameter through the center displaces 3.30 pounds of iron. Hence the net weight of the casting is 16.50 pounds.

A similar casting 7 inches in length will weigh 23.10 pounds. A hole in the center for the same size handle will reduce the weight to 19.80 pounds. With these figures as a base, you easily may work out others to suit a pattern of different shape or dimensions.

Another shop method for determining the weight of the casting is to rough out a pattern to the approximate size, including the hole in the center, and weigh it. A yellow pine pattern weighing one pound is equivalent to 14.1 pounds in iron. A pattern for a 16-pound casting will

weigh 1.13 pounds, or 1 pound, 3 ounces. A pattern for a 20-pound casting will weigh 1 pound, 6 ounces. Having determined the weight, the rough pattern then is trimmed to suit.

Suggests Ways and Means To Prevent Segregation of Lead

Will you kindly advise us as to your experience in making castings using 50 per cent copper and 50 per cent lead. We have made several attempts but have trouble with the metals segregating.

Production of copper 50 alloy is made regularly by a large number of people with good success, and it is our impression that in most of these cases the primary precaution is protection from the absorption of the gases or combustion while the metal is melting in the furnace. Copper readily absorbs gases that are not completely burned such as hydrogen, etc. The best practice is to use oxidizing atmosphere; one that will even produce a certain amount of copper oxide in the copper will be found to give much better results than when a reducing atmosphere is used. This means melting as rapidly as possible.

Some manufacturers add copper oxide to the copper before the lead is added. Others add about 1 per cent of barium sulphate. This is an oxidizing medium and will oxidize on copper causing the presence of a certain amount of copper oxide in the bath.

In our opinion, there really is no necessity for the use of either copper oxide or barium sulphate, if the melting is properly done in an oxidizing atmosphere; and the writer personally knows of a number of instances where a high grade product is produced without the use of either of these or any substitute for them.

Presence of charcoal to protect the copper during melting is objectionable since it prevents the copper from being oxidized. Likewise, phosphor-copper or phosphor-tin should not be used as they are deoxidizing agents. This alloy should not be poured at a high temperature and while the surfaces of the casting may exhibit some apparent segregation when the first cut is tooled off, the rest of the casting should be sound and clean and have a slight pinkish color when held in just the right light.

This alloy is largely used in railroad work and since such a large tonnage is produced for this service, it obviously is one that can be made with little or no trouble. If you will check over your furnaces and see that an ample supply of oxygen is available for combustion purposes and that the temperature is maintained just as hot as possible when melting the copper, you should not have any trouble.

Gives Mixture for Facing Sand for Small Steel Castings

We have some small steel castings to make for a local firm and will appreciate advice on how to prepare the facing sand. What ingredients are needed and what proportion are they mixed for about a 500-pound batch.

Because of the extremely high temperature of molten steel the mold facing material must be much more refractory than the facing employed on gray iron, malleable iron or nonferrous castings. Sand deposits in different parts of the country vary to some extent and for that reason individual foundries have developed their own mixtures to suit various castings.

The base of all mixtures is a clear silica sand, that is a sand containing no clay or bonding material. To render that material suitable for molding purpose it is mixed with a small quantity of fire clay or bentonite and usually a small amount of cereal binder. For heavy castings the facing for molds and cores contains all new sand. Varying amounts of old sand are added to the mixture for green sand facing. This old sand, of course, does not mean old sand from an iron or nonferrous foundry. It means silica sand that has become old in steel foundry use. In your particular instance where you require only a small quantity, a satisfactory facing sand may be made from sharp sand 40 shovels, fireclay and cereal binder 1 shovel each.

Exhibitors at the Great Lakes exposition include numerous firms producing castings which are used in products of their own manufacture

Producing Abrasive Surface on Safety Tread

We have a number of inquiries relative to manufacturing cast iron stair treads with an abrasive surface. Can you tell us how those treads can be made with either a plain or checkered surface?

Production of abrasive faced treads is a proprietary process, and essentially consists in the following operations. The mold is made according to the regular procedure, and then the pattern is carefully removed. The mold face then is sprayed with a solution of waterglass or sodium silicate. Following that a thin layer of abrasive grain which may range from No. 12 to No. 30 is screened onto the sprayed mold face through a suitable screen which is selected on the basis of the abrasive grain size. The grain may be either silicon carbide or aluminum oxide.

Then the pattern is placed back in the mold and carefully rapped down to press the abrasive grain into the mold face. The pattern is again removed, the mold face sprayed with waterglass and another thin layer of abrasive grain put in place as described previously.

The pattern again is stamped back, and after removal the mold is skin dried carefully to insure thoroughly dry surface for the reception of the molten metal. At the completion of the drying operation, the molten metal is poured in and to insure a suitable product, the iron should be poured in hot as possible.

Alloys Make Iron Balls Hard and Tough

Years ago we made quite a few balls for milling ores, but for some time have been out of touch with that field. We are now contemplating to go back into production of balls and would like to have some information on use of alloys in making them. We operate a cupola and will cast 3 and 4-inch balls which must be hard and tough to withstand cascading in an 8-foot mill. We will use sand molds and also try iron molds.

There are a wide range of compositions available for making grinding balls, and by that we are referring to the alloy phase. However, the choice of composition will depend considerably on the price you can obtain, for while the alloys increase the life of the balls, they also add to the cost of manufacture, and in too many cases the consumers are unwilling to pay the additional cost.

Since you have made balls in the past, you are familiar with their manufacture, and mainly are interested in adding alloying agents to provide better service. The main alloy to give great hardness is chromium which may be added alone, or in combination with nickel or molybdenum to modify its effect. For example, one authority mentions grinding balls containing 0.70 per cent silicon, 0.70 per cent manganese, and 3 per cent chromium as having a brinell hardness of 490, while others containing 0.40 to 0.50 per cent silicon, 0.50 to 0.60 per cent manganese, and 3.50 per cent chromium had a hardness of 530 to 560.

Another composition with high hardness between 500 and 600 contains about 4 per cent nickel and 2 per cent chromium. Molybdenum also is added to chromium irons as a modifying cent, and it adds greatly as a toughener.

Close Attention Needed in Sand Mixing

To overcome certain conditions incident to the use of sea coal we have found it necessary to add new sand, bentonite or fireclay or other bonding material. We shall appreciate your opinion on the use of bentonite and fireclay from an economical angle.

The subject of reconditioning molding sand that is in constant use is so complex in its almost infinite ramifications, so many variable factors must be considered, that a direct answer to your inquiry is out of the question. Molten iron burns or destroys a certain amount of the bonding element in sand each time a mold is filled. This amount must be restored to the sand to bring it up to the former standard. Sea coal offsets the value of a certain amount of the bonding element in any sand mixture. Only that part of the sea coal in the immediate vicinity of the casting is burned, hence when succeeding additions of sea coal are made to the mixture, cognizance must be taken of the probable amount still present in the sand. The effectiveness of the bond also is influenced by the moisture content, the size of the sand grains and the volume of silt.

Bentonite or fireclay is a concentrated form of bond, as contrasted with new molding sand containing bond material in excess of the amount required in the working mixture. Conditions vary in different foundries depending on whether the sand is mixed by hand or mechanical equipment, or, whether all the sand is treated with sea coal or only a limited amount in the form of facing. The relative cost of new molding sand, fireclay or bentonite in any given locality also must be taken into consideration. Any one of these bonding agents employed intelligently will yield satisfactory results so far as the appearance of the castings is concerned, but the advantage of any one over the others from an economical standpoint in any given foundry, can be determined only by experiment under actual operating conditions. Manifestly, these experiments can be carried out only by a person qualified by training and experience, a man familiar with the shifting values of every element in their almost endless combinations.

Hard To Remove Core from Steel Casting

We have had considerable trouble in removing cores from heavy steel castings. We tried ramming sand in an extra heavy steel 3-inch pipe for a core and found it almost impossible to remove the sand afterward. We shall appreciate your advice on the proper core sand mixture to use.

In many instances it is possible to use a steel pipe for a core without filling it with sand. However, in a heavy section where the metal remains liquid for a considerable period the pipe becomes soft and may yield to the pressure. To prevent this, the pipe is filled with dry silica sand in the natural state, that is without any binder.

Under another set of conditions the pipe is threaded at both ends and fitted with water connections. A water hose is attached to one end to admit the water at ordinary city water pressure. Another hose or short length of pipe carries the water to any convenient drain. The water is started flowing through the pipe *before* any metal enters the mold. We have used this method with a 5-inch pipe, approximately 12 feet in length in the ram for a charging machine.

If a covering pipe is not permissible and you are forced to employ a sand core, several features must be kept in mind. Under the intense heat and pressure, the metal has a tendency to seep between the sand grains, clay binder will fuse and vitrify, and the compression will bind the entire mass into a practically solid block. To prevent this condition the clay should be omitted from the mixture. The sand is bonded with a minimum amount of any of the usual core binders and the outside is sprayed with oil or molasses water to form a hard skin. The core also is coated with silica wash in the ordinary manner. A small amount of silica flour, say 1 part flour to 10 parts sand is added to the sand. The final touch, probably the most important, is to provide a large vent passage. In a 3-inch diameter core this opening might be 1 inch in diameter.

BARTLETT & SNOW'S NEW FOUNDRY BOOK

available on request

• Complete with more than 120 illustrations and 26 engineering diagrams, Bartlett-Snow's new foundry book—Bulletin 75—points the way to cost saving foundry improvements—greater foundry profits.

Eight pages are devoted to typical equipment layouts for small, intermediate, continuous production and crane operated special foundries. These are followed with full details of Bartlett-Snow shakeouts, screens, tempering belts, pug mills, mullers, aerators, distributing systems, hoppers, gates, flask fillers, feeders, mold conveyors, dust collectors, conveyors, elevators and accessory equipment including castings handling, cupola charging skip hoists, crushers, weigh hoppers, etc. Send for one.

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BARTLETT-SNOW
SAND HANDLING AND SAND CONDITIONING EQUIPMENT
MOLD CONVEYORS AND ACCESSORY FOUNDRY EQUIPMENT

Frank M. Meyers

Carl H. Morken

L. J. Wise

Fred L. Riggin

Men of Industry

FRANK M. MEYERS recently became associated with the American Manganese Steel Co., Chicago Heights, Ill., as consultant and advisor in foundry practice in that firm's alloy steel department. He has been active in the foundry field for 29 years and served his foundry apprenticeship with the Allis-Chalmers Mfg. Co., Milwaukee, Wis., working in the molding and core making, machine shop, patternshop, and engineering departments, and also as a foreman. Mr. Meyers received his technical education at the University of Wisconsin, Madison, Wis., and he has spent a number of years as superintendent of foundries of the United States Navy, Washington. He also was general superintendent of foundries, Waterloo Gas Engine Co., Waterloo, Iowa.

For six years he was works manager, Otis Steel Co., Cleveland, having under his supervision open-hearth and converter foundries, pattern and machine shop. For five years he served as works manager, Maynard Electric Steel Casting Co., Milwaukee, Wis. In recent years he has acted as a steel and alloy foundry advisor in metallurgy, sand mixing, molding, and gating, and has developed special methods for green sand molding and for gating small steel castings.

♦ ♦ ♦

CARL H. MORKEN recently was appointed director of engineering sales, Carondelet Foundry Co., St. Louis. Mr. Morken was graduated from the University of Minnesota in 1922, with a degree in chemical engineering. From 1922 to 1925 he was identified with several foundries in Minneapolis and in the latter year became plant metallurgist for the Ohio Brass Co., Mansfield, O. where he was engaged in both ferrous and nonferrous metallurgy. In 1930 he joined the Detroit Electric Furnace Co. as foundry engineer, resigning that position to become connected with the Carondelet Co. His work will be in the development and sales of electric furnace iron castings for special applications, a field in which that foundry has been engaged during the past 5 years.

♦ ♦ ♦

L. J. WISE, new chairman of the Chicago chapter, American Foundrymen's association, is manager of research and development for the Chicago Malleable Castings Co. and its affiliate, Allied Steel Castings Co., Chicago, as well as assistant sales manager of both companies. Mr. Wise was graduated from Washington university, St. Louis, in 1922 with the degree of bachelor of science in chemical engineering. From 1922 to 1924 he was assistant plant metallurgist for the National Malleable & Steel Castings Co., East St. Louis, Ill., and for the following two years was chief chemist and metallurgist for the Muncie Malleable Foundry Co., Muncie, Ind.

Following two years' association with the Terre Haute Malleable & Mfg. Co., Terre Haute, Ind., Mr. Wise went to Chicago with the Chicago Malleable Castings Co. as metallurgist in charge of the laboratory and annealing departments. In 1930 he was made general foreman in charge of hard iron cleaning, annealing, finishing and shipping departments, in addition to the laboratory. Three years later he was given charge of sales development work including new uses for malleable iron. He has held his present position since April 1, 1935.

♦ ♦ ♦

FRED L. RIGGIN has succeeded O. B. MUELLER as president of the Mueller Brass Co., Port Huron, Mich. Mr. Riggin has been associated closely with Mr. Mueller for many years, having started with the original Mueller company in Decatur, Ill., 32 years ago. When the present company was established at Port Huron in 1917, he took over active direction of sales and some time ago was chosen executive vice president of the company.

♦ ♦ ♦

HUTTON H. HALEY, RALPH J. HUTCHINSON, HOWARD LUNGREN and WILLIAM BLEIL, recently formed Hutton H. Haley and Associates, Detroit. The organization will represent exclusively in Michigan the lines of equipment of the American Foundry Equipment Co.; Bryant Machinery & Engineering Co.; Howell Industrial Truck Co.; Milwaukee Foundry Equipment Co.; Aerovent Fan Co.; Ajax Flexible Coupling Co.; and the Eastern Corp., New York.

♦ ♦ ♦

A. C. FIELDNER, chief engineer, experiment stations division, United States bureau of mines, Washington,

(Continued on page 42)

SYMBOLIC SPO OF BETTER MOLDING MACHINES

No. 110-J Portable Jolt Squeezer

No. 110-JS Sand Straddler Jolt Squeezer

No. 110-PJ Stationary Jolt Squeezer

A SPO line of Jolt Squeezer Molding Machines with 10-inch squeeze cylinder diameter which meets the most exacting foundry operating conditions.

Flexibility in handling a large range of flask sizes, ease of operation, durable construction and simplicity of design is your assurance of higher mold production at lower cost.

Without obligation SPO engineers will be glad to call and discuss your molding machine requirements.

SPO Incorporated

Manufacturers of a Complete Line of Molding Machines and Vibrators

EAST 61st ST. AND WATERMAN AVE., CLEVELAND, O.

•

Your equipment dollars go further and come back quicker with SPO molding machines.

(*Continued from page* 40)
was elected president of the American Society for Testing Materials at the annual meeting. Following his graduation in chemical engineering from Ohio State university in 1906, and a short apprenticeship with the Denver Gas & Electric Co., Mr. Fieldner became fuel chemist in the United States Geological Survey at Pittsburgh. In 1910, when this work was transferred to the newly-created bureau of mines, he was placed in charge of the fuels chemical laboratory and later of the gas investigations laboratory. During the war, Mr. Fieldner was active in various types of development work. In 1927 he was placed in his present position. He is an active member of numerous

A. C. Fieldner

societies and institutes and recently was honored with a doctor of science degree at the University of Alabama.

♦ ♦ ♦

JAMES F. KEMP has been appointed purchasing agent for the Pittsburgh Steel Foundry Corp., Glassport, Pa. He succeeds J. B. WILSON.

♦ ♦ ♦

BENJAMIN D. BROWN, formerly treasurer of Albion Malleable Iron Co., Albion, Mich., has been elected president in addition to his duties as treasurer. Mr. Brown fills the vacancy caused by the death last February of H. B. PARKER, president and general manager of the company.

♦ ♦ ♦

J. HEPWORTH, M.P., (see page 76) elected junior vice-president of the Institute of British Foundrymen at the Glasgow conference on June 9 began his career at 10 years of age, in a textile factory in Bradford, Yorkshire. At the age of 15 he went as an engineering apprentice to the firm of Thornton & Crebbin, of Bradford. Sometime later he was appointed manager of the firm of E. P. Grandage (Tools), Ltd., of which firm he remained the general manager for a period of 12 years. Throughout the years during which he started his industrial career, he attended night schools — up to the age of 24.

After relinquishing his position with E. P. Grandage (Tools), Ltd., Mr. Hepworth became associated with his father, who was one of the founders of the firm of Hepworth & Grandage, Ltd., Bradford, manufacturers of pistons, piston rings, and valve makers and ironfounders.

In 1931, Mr. Hepworth put up as candidate for parliament and was elected in Bradford — the constituency in which he was born. He was again elected in 1935. In the meantime, he retired from the firm of Hepworth & Grandage, Ltd., as managing director, in 1933, and he is now chairman and managing director of the Bradford Piston & Piston Ring Co., Ltd.

♦ ♦ ♦

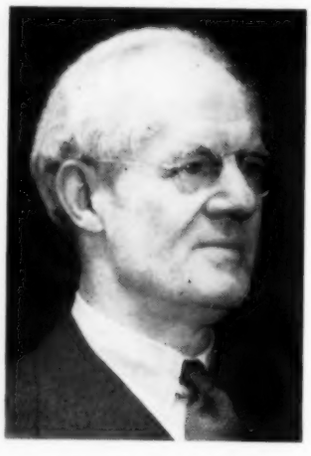
VICTOR U. LEISHER has retired, after 37 years service, from the employ of the T. B. Wood's Sons Co., Chambersburg, Pa. A foreman in the shops, he was in charge of the foundries and pattern works. Mr. Leisher recently was presented with a gold Elgin pocket watch by the men of the departments under his charge.

♦ ♦ ♦

SOL EINSTEIN has been elected a vice president of the Cincinnati Milling Machine Co., Cincinnati. He started with the company in 1903 as a tracer. Becoming next a detailer and designer, Mr. Einstein rose steadily until he reached the position of chief engineer, which he has occupied since 1920. His new work is principally concerned with special engineering and patent matters.

♦ ♦ ♦

CHARLES P. KNUPFER has been appointed general sales manager of the Carborundum Co. and will be located in Niagara Falls, N. Y., main location of the company's plant, sales and executive offices. Mr. Knupfer represented the Carborundum Co. for many years as continental sales manager in Europe.



Charles P. Knupfer

♦ ♦ ♦

C. Q. SWENSON has been appointed Michigan representative by the Michiana Products Corp., Michigan City, Ind., in the Detroit and Michigan territories. His offices are at 2842 West Grand boulevard, Detroit.

♦ ♦ ♦

T. G. DELBRIDGE, manager of the research and development department of Atlantic Refining Co., Philadelphia, was elected vice president of the A. S. T. M. at the annual meeting. Mr. Delbridge was instructor in chemistry at Cornell university from

T. G. Delbridge

1904 to 1909 when he became chemist for Atlantic Refining Co. Since that time he has become assistant superintendent, chief chemist, assistant plant manager and manager, his present position. He has contributed especially to developments in distillation methods, solvent refining, wax manufacturing and methods of testing. He has been active on committees of the A. S. T. M. for several years. Mr. Delbridge is a member of the Franklin institute, American Petroleum institute and the British Institute of Petroleum Technologists. He has written extensively on petroleum refining subjects.

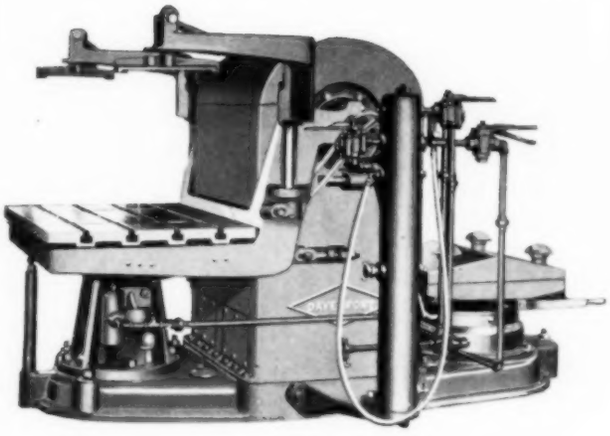
♦ ♦ ♦

CARL J. EBERLY has been appointed Detroit representative of the Newark Wire Cloth Co., Newark, N. J. Mr. Eberly's address is 2-251 General Motors building.

♦ ♦ ♦

R. E. BROWN has been appointed district manager of the company's San Francisco office. Mr. Brown joined the organization in 1920 soon after his graduation from Lehigh university, and for the past 11 years he has been engaged in the sale of ferroalloys and metallurgical work on the Pacific Coast.

ADVERTISING PAGES REMOVED



No. 28A Davenport With Hand Clamps

Melt Borings

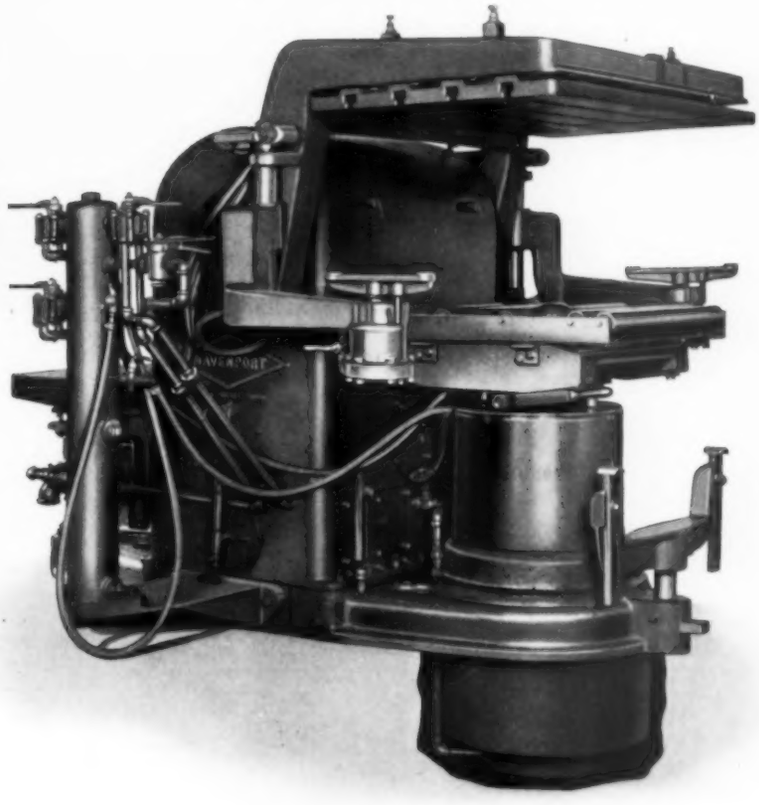
No. 103 Jolt Squeezer

350 TON MILWAUKEE BRIQUETTING PRESS

Conserve cast iron borings and get better metal control by briquetting.

No. 28A
DAVENPORT JOLT ROLLOVER DRAW
With Air Clamps and Roll-off Device

Entirely air operated, mold completely finished without operator leaving the control column.



EQUIPMENT COMPANY

WISCONSIN **CABLE ADDRESS "MILMOLDCO"**

Shrinkage

by H. A. Schwartz

Eighth Installment

Problem 17

REQUIRED the time needed for a casting 1000 centimeters long (40 inches), 200 centimeters (8 inches) wide at one end and 250 centimeters (10 inches) wide at the other, 5 centimeters (2 inches) thick, made in a sand mold, to cool 100 degrees Cent. (180 degrees Fahr.) from a pouring temperature 1200 degrees Cent. (2190 degrees Fahr.) above room temperature. There is 10 centimeters (4 inches) of sand below the casting, 15 centimeters (6 inches) above. The mold is 1100 centimeters (44 inches) long and 350 centimeters (14 inches) wide.

It is assumed that the casting remains always *uniform* in temperature, that the amount of heat absorbed by the sand itself is negligible and heat is assumed to travel only perpendicularly to the mold surface. All temperatures are measured *above room temperature*. To obtain thermometer temperatures the temperature of the room must be added to any temperature.

Consider first the cooling rate had the sand thickness been unity (1 centimeter) all over. If the temperature of the metal be θ the number of heat units conducted outward in unit time per unit area would have been θk where k is the conductivity of sand taken from tables as about 0.0049. The surface area of the entire casting would be

$$2 \times 1000 \times \frac{200+250}{2} + 5 \times 200 + 5 \times 250 + 2 \times 5\sqrt{1000^2+25^2}.$$

This area is 462,253 square centimeters so that the heat conducted away per unit of time would have been $(462{,}253 \times 0.0037)\ \theta$ calories per second or 2265 calories per second.

Now the volume of the casting is $1000 \times \frac{250+200}{2} \times 5$ or 1,125,000 cubic centimeters, and its weight is 1,125,000 ρ grams where ρ is the density of the particular metal involved. If c is the specific heat of this metal, then the change of heat content accompanying a change of temperature of 1 degree Cent. would be 1,125,000 ρc, and the change of temperature accompanying a change of heat content of 2265 calories would be

$$\frac{2{,}265}{1{,}125{,}000\,\rho c} = \frac{0.002}{\rho c} \text{ degrees (very nearly)}$$

and the cooling rate of this casting would have been $\frac{0.002}{\rho c}\ \theta$ degrees (Cent.) per second. At the moment when the mold is filled $\theta = \theta_o$ would be 1200 and the cooling rate would be $\frac{2.4}{\rho c}$ degrees Cent./second and it will of course decrease as the casting cools. We have earlier in these discussions found that for a cooling rate proportional to temperature the relation

$$\log_e \frac{\theta}{\theta_o} = a\,t$$

exists. In our problem a is $\frac{0.002}{\rho c}$, $\theta_o = 1200$ and

$$\theta = 1200 - 100 = 1100 \text{ degrees,}$$

hence

$$\log_e \frac{1100}{1200} = -\frac{0.002}{\rho c}\,t^{53}$$

$$0.08701 = \frac{0.002}{\rho c}\,t$$

and

$$t = 43.5\,\rho c$$

Thus far, for a casting surrounded by 1 centimeter of sand, the calculation has not concerned itself with mold dimensions. The rate of surface to volume of the casting is $\frac{462253}{1125000}$ or 0.411.

Remembering now that the cooling rate is inversely as the sand thickness, we find that the upper surface of the casting covered by 15 centimeters of sand instead of 1 centimeter, will cool only 1/15 as fast as it would if the layer had been 1 centimeter thick. We could have obtained the same amount of cooling as will exist through 15 centimeters of sand by insulating 14/15 of the surface and covering 1/15 with a layer of sand 1 centimeter thick. In this way we may compute the *equivalent* cooling area of the casting as follows:

$$\frac{225000}{15} + \frac{225000}{10} + \frac{1000}{5} + \frac{1250}{5} + 2\,\frac{1000 \times 5}{\frac{1}{2}\left(\frac{350-250}{2} + \frac{350-200}{2}\right)}$$

This becomes 37,990 square centimeters for the equivalent cooling surface and the ratio of *equivalent* surface to real surface is thus

$$\frac{37990}{462.253} = 0.0821$$

and the ratio of equivalent cooling surface to volume becomes $0.0821 \times 0.411 = 0.3374$. The casting cools only 0.0821 times as fast as it did before and the cooling time for 100 degrees Cent., which varies inversely as the cooling rate, is

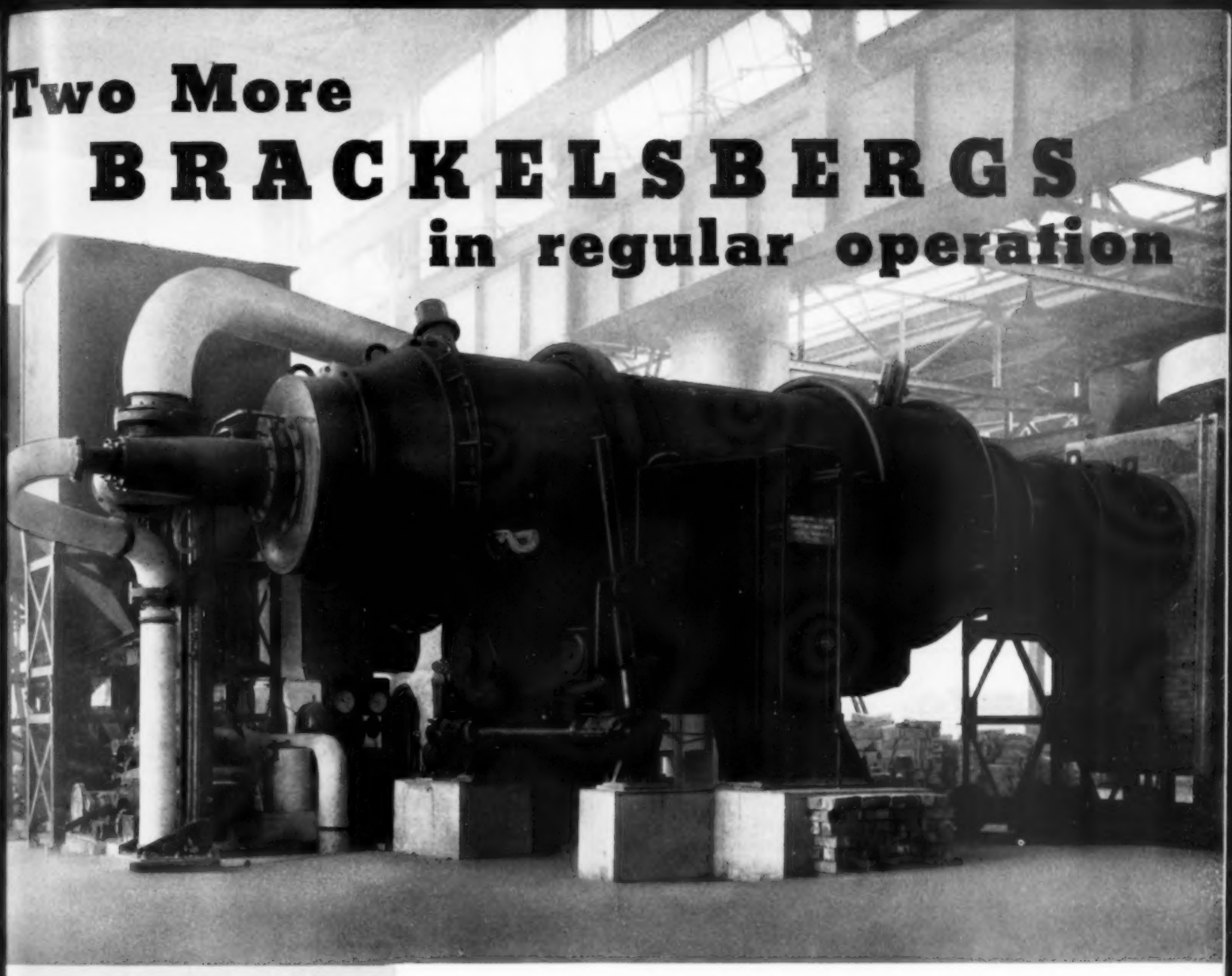
$$\frac{43.5}{0.0821}\rho c = 530\,\rho c$$

It is a simple application of the same reasoning to conclude that the time required for a casting to freeze, after having cooled to the freezing point also is measured by a similar constant except that the latent heat of fusion takes the place of specific heat. The freezing time thus becomes inversely proportional to the product of density and

(*Continued on page* 48)

Footnote references will be found at the end of this installment starting on page 50.

Two More BRACKELSBERGS in regular operation



BRACKELSBERG HIGH SPOTS

High metal temperatures, 2850°F. or higher, depending upon refractories used.

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Low Fuel Cost— Half the cost of coke in a cupola or coal in an air furnace, and only a fraction of the cost of electric power.

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Close Metallurgical Control over a wide range.

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Flexibility—3 to 12 heats a day, each one of different analysis if desired.

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Low Cost of Power and Labor.

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Low Refractory Costs.

We Also Build —

Electric Traveling Cranes — Cupolas — Cupola Chargers—Air Furnaces—Steel Converters — Ladles — Quick-Anneal Ovens — Tumbling Mills — Dust Filters — Stokers for Core Oven Firing — Pulverized Coal Equipment.

Another automotive foundry has adopted the Brackelsberg rotating furnace for its new plant (recently put into operation), melting gray iron.

The furnaces shown above are being used for special analyses such as cam shaft iron, brake drum iron, clutch plate iron, fly wheel iron, etc.

Note tapping spout on side of the cylindrical shell — provision is made to reverse furnaces. Side tapping facilitates pouring into monorail ladles.

Furnaces are furnished with replaceable nose pieces on both front and rear cones. The center line of the furnace for pouring into hand ladles is 5′6″ above floor line.

Let us send you the whole story of the Brackelsberg. Ask for Bulletin 197.

WHITING CORPORATION
15607 Lathrop Avenue, Harvey, Illinois

WHITING

PIONEERS SINCE 1884

(*Continued from page* 46)

latent heat of fusion and directly to the ratio of equivalent cooling surface to volume.

We have thus set up a basis upon which to base a rule for the *estimation* (not for the accurate computation) of the cooling rate, cooling time and freezing time of a casting cooling in sand as follows:

Divide the projected area of each face of the casting on the mold surface to which the heat from that face can most readily travel by the average distance between the face and the surface and add all the quotients. Divide this sum by the casting's volume. The result is the corrected coefficient or modulus of cooling rate and all combinations of castings and mold forms having the same modulus cool at the same rate. Call this modulus Z. The cooling rate in a sand mold is

$$\frac{0.0037\ Z\ \theta}{\rho c} \qquad (17)$$

where θ is the temperature *above room temperature* and ρ and c are the density and specific heat of the metal. The cooling time from θ_a to θ is given by

$$\frac{\rho c\ log_e\ \frac{\theta}{\theta_a}}{0.0037\ Z} \qquad (18)$$

and the freezing time by

$$\frac{\rho\ L}{0.0037\ Z\ \theta_f} \qquad (19)$$

where θ_f is the freezing point.

This approximation yields values which are in error in the sense that actual cooling will be more rapid than that estimated. We have neglected the conductivity of those portions of the mold at the corners and edges which also cool the casting. There is another source of error especially at the beginning of pouring because the heat capacity of thick sand layers is not negligible. More complex methods of estimation could be suggested which would in part cancel these errors but considering the many other uncertainties in arriving at the data this is deemed a needless refinement.

For very irregular castings it becomes difficult to judge just what paths the escaping heat may take and the precision grows constantly less[55]. To the extent that these estimations are accurate one might design an adequate feeder for a given casting on the following considerations: If Z_1 is the coefficient for the feeder and Z_2 that for the casting, then in order that the feeder shall not have solidified at all by the time the casting has frozen,

$$-\frac{\rho c\ log_e\ \frac{\theta_f}{\theta_a}}{0.0037\ Z_1} < -\frac{\rho c\ log_e\ \frac{\theta_f}{\theta_a}}{0.0037\ Z_2} + \frac{\rho L}{0.0037\ Z_2\ \theta_f}$$

which permits by substitution of known values for ρ, c, θ_f, θ_a and Z_2 the calculation of a maximum value of Z_1 by substituting the sign of equality for the inequality of the previous expression. Also obviously the volume of the feeder must be *at least* equal to the contraction of the volume of the casting from liquid at θ_a to solid at θ_f.

From these considerations it is possible to calculate whether a feeder of given proportions will completely feed a given casting even though its coefficient, Z, may not be so small as to keep it completely liquid until the casting is completely frozen.

One may evaluate the expression $-\frac{\rho c\ log_e\ \frac{\theta_f}{\theta_a}}{0.0037\ Z}$ for the feeder and thus find the time when the feeder begins to freeze. So that the feeder may function as such this must be greater than the time required for the casting to begin to freeze. By deducting from the time when the feeder *begins to freeze* the time when the casting begins to freeze one obtains the time during which the casting has been solidifying. The ratio of this time to that calculated from $\frac{\rho L}{0.0037\ Z_2\ \theta_f}$ represents the proportion of the casting which has frozen since equal amounts of heat leave the casting in equal times during freezing.

Assuming that we have data as to the density of solid metal, the expansion on melting and the coefficient of expansion of the liquid obviously we can calculate what contraction of volume has taken place when the liquid metal, which originally filled the mold (feeder and casting), has cooled throughout to the melting point and frozen to the extent indicated by the preceding calculation. The level of liquid in the feeder dropped by an amount equivalent to this change of volume, the surface remaining level.

We now abandon all considerations of the original dimensions and center our attention upon a volume, V, of liquid remaining in the casting and a feeder filled to a height, H, (less than its full height) with liquid metal all at the freezing point. We may calculate the rate at which the liquid metal surface will sink in the feeder[56]. An expression will be found indicating that the depression of the liquid level originally at height, H, in the feeder is at time, t,

$$\frac{Z_1V_1 - Z_2V_2}{Z_1A_1}\ log_e\ \frac{\rho L - 0.0037\ \theta_f Z_1\ t}{\rho L} \qquad (20)$$

Time is counted from the moment when the feeder begins to freeze. We are not interested in any events after the casting has frozen solid.

The casting freezes solid in time (counting now from the moment of pouring).

$$\frac{\rho L}{0.0037\ Z_2\ \theta_f} - \frac{\rho c\ log_e\ \frac{\theta_f}{\theta_a}}{0.0037\ Z_2}$$

and the feeder begins to freeze in time

$$\frac{\rho c\ log_e\ \frac{\theta_f}{\theta_a}}{0.0037\ Z_1}$$

hence the longest time counting from the moment the feeder begins to freeze which is of interest to us is

$$\frac{\rho L}{0.0037\ Z_2\ \theta_f} - \frac{\rho c\ log_e\ \frac{\theta_f}{\theta_a}}{0.0037\ Z_2} + \frac{\rho c\ log_e\ \frac{\theta_f}{\theta_a}}{0.0037\ Z_1} = t$$

If we substitute this value of t in (20) we may calculate how far the liquid surface has fallen when the casting has frozen and since this surface must not have sunk into the casting, H must be as great as this calculated value of h to prevent a pull into the casting.

Note that we here assume that the casting and feeder are each of uniform temperature within themselves but they need not be of the same temperature. This may be due mainly in practice to the very usual custom of having the feeder communicate with the casting by a *mouth* of smaller cross section than the feeder or casting. This subject will be dealt with more fully later.

If, in the preceding discussion, we desire to find the minimum size of feeder we must compute the cooling coefficient for a variety of diameters and heights, determine which heights are sufficient and from a table of usable heights and cross sections compute the volumes and locate the minimum.

The greatest uncertainty in this whole process consists of the determination of the cooling rate coefficients for in even rather simple combinations of forms it becomes a matter of pure guess work to arrive at the path taken through the mold material by the heat flow from each unit of surface. Consider, for example, a rectangular flat plate cast horizontally in a mold. It may not be very rash to suppose that the heat flows substantially all in line at right angles to the plate's surfaces and to the mold surfaces parallel thereto. But suppose now that we set on the

(*Continued on page* 50)

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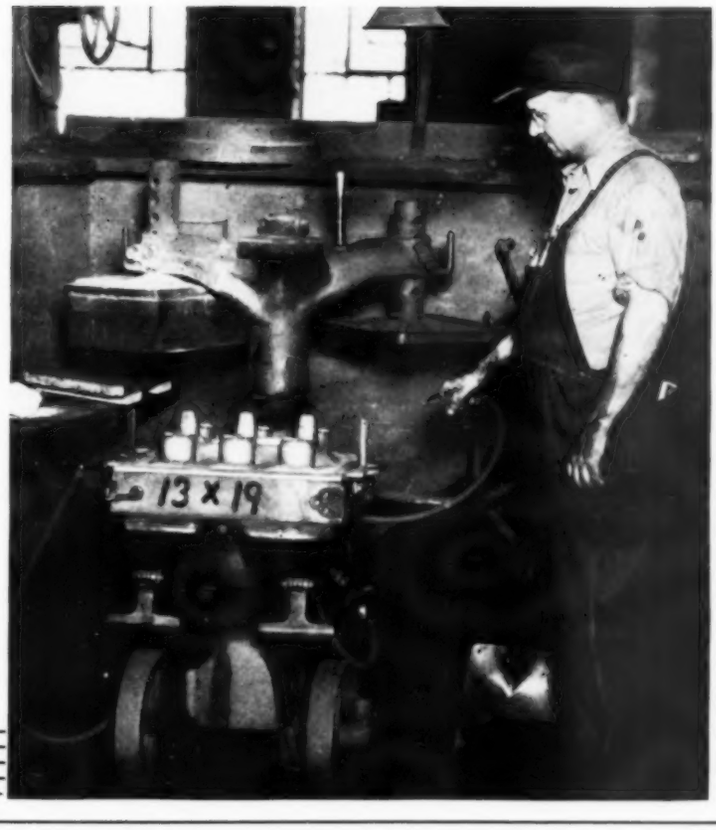

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(*Continued from page* 48)

middle of the upper surface a cylindrical feeder extending through the cope. The heat from the feeder's vertical surface must pass out through the mold either in horizontal lines to the mold's sides which may be far distant or in inclined lines leading to the mold's upper surface. In any event they come into conflict with the vertical flow of heat from the casting through the cope and who can say where the resulting heat currents will flow?

It seems that this problem can be solved for the present purpose only by a series of experiments on a considerable variety of forms and sizes of castings (feeders included) in a variety of mold sizes. Such experimentation might give empiric rules for computing the probable values of Z. Be it observed that we have developed an expression for the time elapsing between the beginning and end of freezing in terms of a metal's density, latent heat of fusion and melting point and of the coefficient Z.

If therefore we pour a given casting around a thermocouple suitably placed in the mold and observe the time during which the temperature remains constant at the freezing point for a metal of known properties we have a means of determining Z for the several parts of an assembly of castings and feeders. The changes of Z accompanying various experimental changes, say in the size and location of the feeder in the preceding illustration, would furnish an experimental foundation for at least some improvement in our ability to estimate the paths of heat flow and hence Z in similar cases.

(*To Be Concluded*)

[52] The quantity under the square root sign is the length of the edge of the casting, greater than that of the casting because the latter tapers in width.

[53] The sign is negative for time increases as temperature decreases, the formula is for a heating rate of a so that a is negative for a cooling rate.

[54] In the last term 1000 is the length of the casting measured parallel to the length of the mold. Since the heat flow is perpendicular to the *mold* surface, we measure not the true length, 1000.3, of the edge but the length of its projection on the mold edge. The denominator is the average thickness of the sand along the edges.

[55] It sometimes is convenient to consider that the heat travels from curved casting surfaces to the mold surface along lines normal to the casting surface and to solve for the mean cross section and mean length of the path by polar co-ordinates. This treatment is considered mathematically beyond the scope of the present method of treatment although it should offer no difficulty at least in the simpler cases, to those who have been adequately instructed in the calculus.

[56] The metal freezing in an infinitesimal time, dt, in the casting is $\frac{0.0037\ Z_2\ \theta_f}{\rho L_c} V_2\ dt$ and in the feeder

$$\frac{0.0037\ Z_1\ \theta_f}{\rho L_c} V_1\ dt$$

when V_2 and V_1 are the respective volumes of casting and feeder. The shrinkage due to freezing in any infinitesimal time, dt, is

$$d\ v = \frac{0.0037\ \theta_f}{\rho\ L_c} (Z_1\ V_1 + Z_2\ V_2)\ \phi\ dt$$

where ϕ is the coefficient of contraction on freezing. Since one may ordinarily assume a feeder to cool mainly from its vertical surfaces, we may get an expression for the rate at which the feeder freezes by saying that if A be the (supposedly uniform) horizontal cross section of the feeder and $d\ a$ the *decrease* in area.

$$\frac{d\ a}{A} = \frac{.0037\ \theta_f}{\rho\ L_c} Z_1\ dt$$

whence the area, a, at time, t, is

$$a = A\ \left(1 - \frac{.0037\ \theta_f}{\rho\ L_c} Z_1\ t\right)$$

but since the change of volume of metal is made up by a fall in the surface of the liquid we may say that $d\ v = a\ d\ h$ whence

$$a\ dh = \frac{.0037\ \theta_f}{\rho\ L_c} (Z_1\ V_1 - Z_2\ V_2)\ \phi\ dt$$

$$dh = \left\{\left[\frac{.0037\ \theta_f}{\rho\ L_c} (Z_1\ V_1 - Z_2\ V_2)\ \phi\right] + \left[A\ \left(1 - \frac{.0037\ \theta_f}{\rho\ L_c} Z_1\ t\right)\right]\right\} dt$$

$$= .0037\ \theta_f\ (Z_1\ V_1 - Z_2\ V_2)\ \phi\ \frac{dt}{A\ (\rho\ L - .0037\ \theta_f\ Z_1\ t)}$$

but $d \cdot A\ (\rho L - 0.0037\ \theta_f\ Z_1\ t) = -0.0037\ \theta_f\ Z_1\ A\ dt$ hence

$$dh = -\frac{0.0037\ \theta_f\ (Z_1\ V_1 - Z_2\ V_2)\ \phi}{0.0037\ \theta_f\ Z_1\ A} \cdot \frac{dA\ (\rho\ L - 0.0037\ \theta_f\ Z_1\ t)}{A\ (\rho\ L - 0.0037\ \theta_f\ Z_1\ t)}$$

$$= \frac{(Z_2\ V_2 - Z_1\ V_1)\ \phi}{Z_1\ A} d \cdot \log_e A\ (\rho\ L - 0.0037\ \theta_f\ Z_1 t)$$

$$h = \frac{Z_1\ V_2 - Z_1\ V_1}{Z_1\ A} \log_e A\ (\rho\ L - 0.0037\ \theta_f\ Z_1\ t) + I$$

which must be zero when $t = 0$ hence

$$I = -\frac{Z_2\ V_2 - Z_1\ V_1}{Z_1\ A} \log_e A\ \rho\ L$$

and

$$h = \frac{Z_2\ V_2 - Z_1\ V_1}{Z_1\ A} [\log_e A\ (\rho\ L - 0.0037\ \theta_f\ Z_1\ t) - \log_e A\ \rho\ L]$$

$$= \frac{Z_2\ V_2 - Z_1\ V_1}{Z_1\ A_1} \log_e \frac{\rho\ L - 0.0037\ \theta_f\ Z_1\ t}{\rho\ L}$$

Chicago Chapter Of A. F. A Elects Officers

Dee D. Cameron, Pratt & Letchworth Co., Buffalo, was the principal speaker at the last monthly meeting of the 1935-1936 season of the Chicago Chapter, American Foundrymen's association, held June 15. Mr. Cameron's talk on "Foundry Practice" was concerned principally with the subject of sand.

The speaker outlined the practice followed in his foundry in the preparation of sand for steel castings, indicating that synthetic sand was preferred to naturally bonded material. Advantage of round grain sand over angular shapes in obtaining the desired permeability was illustrated by slides showing the arrangement of these different types of grain.

A typical sand mixture was given for small castings. This consisted of the addition of 8 quarts of fireclay and 1½ gallons of organic binder to 20 cubic feet of straight green sand. Molasses water, but no additional organic binder, is added for sand used in molds for castings of 1000 pounds and over. A cleaning system is employed in removing fines from the sand.

Annual election of officers was held at the June meeting. L. J. Wise, Chicago Malleable Castings Co., was named to succeed James Thomson, Continental Roll & Steel Foundry Co., as chairman. Other officers chosen were: Vice chairman, H. W. Johnson, Greenlee Foundry Co.; secretary, F. B. O'Neil, Western Foundry Co.; treasurer, C. C. Kawin, Chas. C. Kawin Co. The following new directors were named: W. C. Packard, National Engineering Co.; C. O. Thieme, H. Kramer & Co.; James Thomson; and C. E. Westover, Burnside Steel Foundry Co.

Meetings of the Chicago chapter will be resumed in the fall. The annual outing and golf tournament has been set for Sept. 12 at Lincolnshire country club, with T. J. Magnuson, J. S. McCormick Co., chairman of the entertainment committee in charge of the program to be presented on that occasion.

Philadelphia Chapter Holds Outing

Members of the Metropolitan Philadelphia Chapter of the American Foundrymen's association, business associates and friends held their first annual chapter outing on June 12 at the Whitemarsh Valley country club, Philadelphia.

Stanley Kirn led the foundrymen against the supplymen captained by Floyd Goodfellow in a baseball game, several rounds of golf were played, the quoit courts were open and refreshments were served in the afternoon. The program for the evening included dinner, music and singing and entertainment following the dinner.

Foundrymen Entertained

The Connecticut Nonferrous Foundrymen's association held its annual entertainment at the Hollywood inn, Ansonia, Conn., June 16. The program included 12 vaudeville acts.

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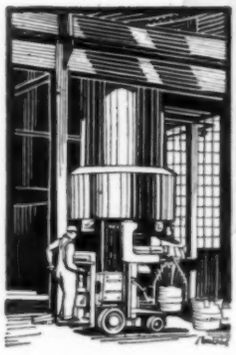


Viewing Foundry Developments . . . AT SHORT RANGE

LADLE additions of ferromanganese to increase the manganese content of regular malleable cast iron to 1 per cent or more, and of 1 per cent copper will retard graphitization during heat treatment, and result in the production of pearlitic malleable iron with a tensile strength of 70,000 pounds per square inch, a yield point of 53,000 pounds per square inch, and an elongation of 7 per cent in 2 inches.

♦ ♦ ♦

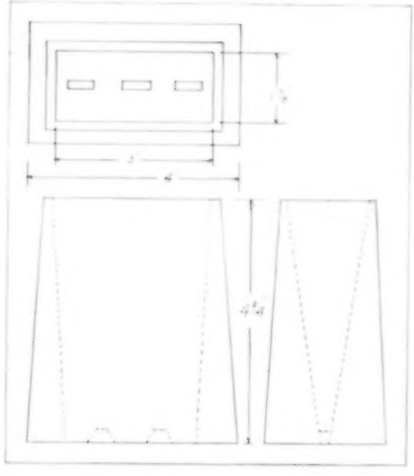
For lining the ladles, a large gray iron foundry favors a composition made up of 2 parts pulverized fire brickbats, 2 parts old molding sand and 1 part fire clay. The mixture is moistened slightly with water and passed through a muller. The old lining is knocked out and the new material is rammed against the bottom and sides to a thickness of approximately 2 inches. The mixture is built around the wall by hand and then rammed quite hard with a piece of 2 x 2-inch stick about 2 feet in length. The result is a smooth, hard lining which remains in constant service for about a week.

♦ ♦ ♦

Substitution of 0.5 to 5.5 per cent nickel for a corresponding amount of tin in the 88 per cent copper, 10 per cent tin, and 2 per cent zinc alloy has been found to give an excellent composition for catenary clamps and other parts used in the overhead wire suspension systems on an Eastern electrified railroad. The alloy shows a tensile strength of 45,000 pounds per square inch and an elongation of 40 per cent as well as better resistance to corrosion under the salt spray test.

♦ ♦ ♦

THE accompanying illustration shows a dry sand core gate designed originally for use on thin flat plates and other castings of a similar character. It is an adaptation of the finger gate employed extensively in stoveplate foundries. It may be placed in any position in the mold, in addition to the usual position on top. By filing away any desired portion near the bottom, that part of the core may be fitted snugly to uneven contour of a pattern. Also by filing away part of the bottom, the size of the opening may be increased. In the core shown in the illustration the top of the gate where the metal is poured is 1⅜ x 3 inches. Each of the three small openings in the bottom, that is the part adjoining the pattern, measures ⅛ x ½-inch. The design may be adapted to provide any desired size openings.



Top, front and side views of core gate and pouring basin

♦ ♦ ♦

An excellent composition for centrifugal pump casings for handling sands, clays, etc., is made with a 40 per cent steel scrap mixture, and containing 0.80 to 1.0 per cent silicon; 0.60 to 0.80 per cent manganese; 0.20 per cent maximum phosphorus; 1.75 to 2.0 per cent nickel, and 0.50 to 0.70 per cent chromium.

♦ ♦ ♦

Investigation indicates that the thickness of section of a casting is not as great a factor in determining the structure as is the composition of the metal, the degree of superheat, pouring temperature, length of time the metal is held above the critical superheating temperature, and the cooling rate after it has been cast.

NECESSITY of adequate feeding to secure sound castings is clearly illustrated in the case of automobile wheel hubs and brake drums cast integrally. In one foundry the castings are made two-up, and while the pair of castings weigh only 30 pounds, the gross weight of castings, gates and risers is 65 pounds.

♦ ♦ ♦

German and English steel producers have adopted strontianite or strontium carbonate to aid in desulphurization as it acts as a flux or thinning agent, producing for long periods of time a highly fluid, strongly basic slag. It is said to be more effective than fluorspar and does not attack the lining. The usual practice is to add strontianite equal in weight to 1 or 1½ per cent of the charge as soon as the latter is melted. One example cited showed an open hearth heat to contain 0.072 per cent sulphur and 0.250 per cent phosphorus on the first analysis. An hour later strontianite was added, and two hours after that addition the sulphur was 0.027 per cent and the phosphorus, 0.036 per cent. Final analysis of the heat was 0.027 per cent sulphur and 0.030 per cent phosphorus.

♦ ♦ ♦

Some steel foundry operators have observed that use of high temperature cement in place of ordinary fireclay for laying brick in ladles has resulted in as much as 10 per cent increase in ladle lining life, and also has reduced fireclay-type inclusions in the steel.

♦ ♦ ♦

In making a certain type of casting, a French foundry encountered considerable trouble due to impurities collecting at a specified point which resulted from the peculiar shape of the core. Difficulties were said to be overcome by treating the cores with a mixture of powdered aluminum and linseed oil. Liberation of heat through the combustion of the aluminum caused the metal to be more fluid and facilitated the egress of impurities. The aluminum also acted as a deoxidizer and prevented pinholes. Application of the coating is patented.

Just like a feather in the breeze

The Adventures of BILL

By PAT DWYER

WELL, Sir" said Bill the other night as he stretched out in an easy chair and cocked his long feet lazily on the veranda railing " 'Tis really wonderful how easily a man can change his mind. Here a month or two ago I was envying those people who live on the equatorial belt of the earth's surface where clothing practically is unknown. The only artificial fire they see from one year's end to the other is a handful of charcoal employed to cook a special dish maybe once or twice a year when the mother-in-law comes on a visit. After the first ceremonial meal the old lady has to forage for herself the same as the others. Members of the family lie around in the sun all day, perspiring and happy and everything is okiedoke.

"Tonight the idea positively is revolting. Speaking conservatively and with due regard for the beautiful virtue of truth, I estimate that I lost at least one imperial gallon of sweat today. I am not one to become unduly alarmed, but if this hot weather continues and the dehydration process proceeds in corresponding ratio I will have to put lead soles on the shoes, or hang a few pieces of pig iron around my waist to prevent the first moderate breeze from blowing me into the lake. That would be a fine windup for a long and useful life. The only consoling feature is that I probably would get my name—mis-spelled—in the paper."

Business of holding up both hands and reading imaginary newspaper.

Claims He Is Too Light To Sink Man Blown Offshore in High Wind. Fishing tug Annie C., cruising off the breakwater this morning found the allegedly lightest man in town skating around the surface of the water like one of these here now water beetles. Taken aboard and weighed on the fish scale he tipped the beam at 47 pounds with both shoes filled with water. Captain of tug states this is the most remarkable creature ever drawn over the side of his boat. Man and boy he has cruised the Great Lakes for nigh onto forty year and in that time has hooked some queer fish, but this personification of an elongated shredded wheat biscuit has him goggling. Thin man has extraordinary theory to account for condition. Says—"

"If you ask my opinion" I interrupted "you won't of course, but if you ask my opinion, I think you have said about one and one half times too much already. Mind you I am not wishing you any harm, but if that hypothetical tug captain ever does pull you aboard with a boat hook you had better can the chatter and lie low. Short tempered lads these tug boat boys. Men of few words. Irritate 'em just a trifle and over you go, Plop!"

"As I was saying" Bill continued, calmly ignoring this well meant bit of advice "I no longer envy the boys who have nothing to do but lie under a burning sun until one side is thoroughly tanned and then roll over to tan the other side. My ambition at the moment is to join an expedition headed in the general direction of either the south or the north pole. North for choice, since it is the nearer of the two. I knew a fellow who went up there one time with Peary and he speaks very highly of the quality and particularly of the unlimited quantity of the ice. Very tranquil and refreshing, I imagine, on a moonlight night to stretch out in a hollow in a block of ice, listen to the seals and walruses barking playfully, and watch the great stars wheeling across the sky. You don't happen to know if Admiral Byrd or any other of these exploring chaps is preparing for another dash, do you?"

Birds of a feather or something

"No" I admitted "The north and south pole exploring business seems to be at a standstill since the boys brought back word there is nothing there worth lifting, no mineral rights worth exploiting, no land which could be divided into town lots and no population worth ousting to make room for colonists and civilization. Unlimited supply of ice is still there, but up to the present no inventive genius has discovered a method for placing this material at the disposal of mankind. Too long a haul for the iceman. Since you have the exploring bee in your bonnet, why do you not join the American Foundrymen's association Expeditionary Force sailing from New York about the last of August. See France, Switzerland and Germany and hobnob with foundrymen from all over Europe at the International Foundry Congress in Duesseldorf?"

"Well" said Bill "I'll tell you. I was kind of toying with the idea. At one time or another I have worked with molders who learned the trade in Europe. In recent years I have met some of the brass hats doing some touring on this side. Excellent mechanics and all 'round stout fellas who spoke better English in many instances, than some of native sons born right here in this great e pluribus unum United States of America.

(*Concluded on page* 56)

"What will prevent hard spots"?

"How can machinability be improved"?

"What type of mix will produce iron to meet close Brinell hardness specifications"?

"How can I get rid of porous spots"?

The Globe Iron Company daily is helping foundrymen find the answer to these and similar questions.

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GLOBE IRON COMPANY

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SILVERIES BESSEMER FERROSILICONS

"Since 1872"

(*Concluded from page* 54)

I have seen pretty nearly all of this country and I certainly should like to take a gander over Europe before the old boy with the scythe and the hour glass takes a swipe at me."

"Here's your chance to take a look while the looking is good. The news reels on this side show great bodies of armed men tramping hither and yon, but that need not alarm you in a country where soldiering has been one of the chief professions from time out of mind. Like a bull in a pasture armies are harmless if you leave them alone.

"The foundry congress is to be staged in Duesseldorf, one of the great industrial cities on the storied river Rhine. Probably no river in the world is of more importance to such a great number of people. Long before the spear head of Caesar's leathernecks pierced the forests of the North, this great stream has been the scene of stirring events in the world's drama. Since Caesar's day not a century has gone by in which the waters of the Rhine have not run red with the blood of contending armies. Vercingetorix, Charlemagne, Tilly, Wallenstein, Frederick the Great, Napoleon, Bismarck, Moltke are some of the names in the long list of warriors who battled along the banks for command of this great highway.

"Following the bitter days of the '45 when Prince Charlie's men were blown out of Scotland like so many leaves before the gale, a band of the survivors formed a company and offered their swords and their services to one of the then contending armies in the vicinity of the Rhine. How they stormed and captured an island in the river is described by Aytoun in one of the most rousing battle poems ever written. Never a Scot who has read the lines either with or without an accompaniment of the skirling pipes, but has felt his heart expand, the short hairs creep on the back of his neck, the stinging salt tears of emotional ecstasy in his eyes and a wild desire to shout the old ringing battle cry of his forefathers."

"Hoot mon!" said Bill. "It must a bin a gey bonny fecht."

"Bonny is not the word for it. The enemy was a tough outfit. The pick of the army.

But never had they faced in field
So stern a charge before;
And never had they felt the sweep
Of Scotland's broad claymore.

"Yes, my boy, as the modern phrase hath it, brother Aytoun goes to town right handsomely in his account of that ancient bit of bickering. It might be worth your while to take a look at the place known down to this day as the *Island of the Scots*."

"That's what you think. You certainly are one optimist. With practically the entire map of Europe turned inside out, plowed under and remade in the past two decades, it is extremely unlikely that a little two by four island has retained its original name. I shall not be surprised to find that the island now is known as No. 3 or possibly tiddlywinks. On what evidence do I base this sweeping conclusion? An island in San Francisco bay once known by the sonorous Spanish title of Yuerba Buena —Do you know what the natives call it now? Goat Island! The liquid Spanish Yerbawayna, is not hard to say, but every person says Goat Island. Then there is an island in the Detroit river on which the early French explorers conferred the name of Bois Blanc on account of the great number of white birch trees. Detroiters run excursions down there now on Sundays and holidays. The name of the island and the name of the boat that takes these merry roisterers to their destination is Bob-Lo!"

"You'll find none of that levity in Germany. When these solid German lads put a long double acting, compound, articulated, toggle jointed name on anything, that name is there to stay.

"On an island in the river near Bingen is the famous Mouse Tower, *Mausethurm*, where the hard hearted arch bishop Hatto was attacked and eaten by the rats—"

"An orchid to the rats" said Bill. "I hope they felt no ill effects from their hearty meal. I remember reading something about that when I was a young gossoon, but I had forgotten all about it until you sprung it just now. Stole all the people's grub or sweated the everlasting life out of them in taxes or something didn't he?

"Bingen on the Rhine! 'A soldier of the Legion lay dying at Algiers, there was lack of woman's nursing, there was dearth of woman's tears. But a comrade stood beside him while his life blood ebbed away and bent with pitying glances to hear what he might say.'

"Boy" said Bill, his eyes sparkling "do you remember that one?"

"I have read it. Written if the old memory serves me correctly by a lady who signed herself Caroline Norton. What about it?"

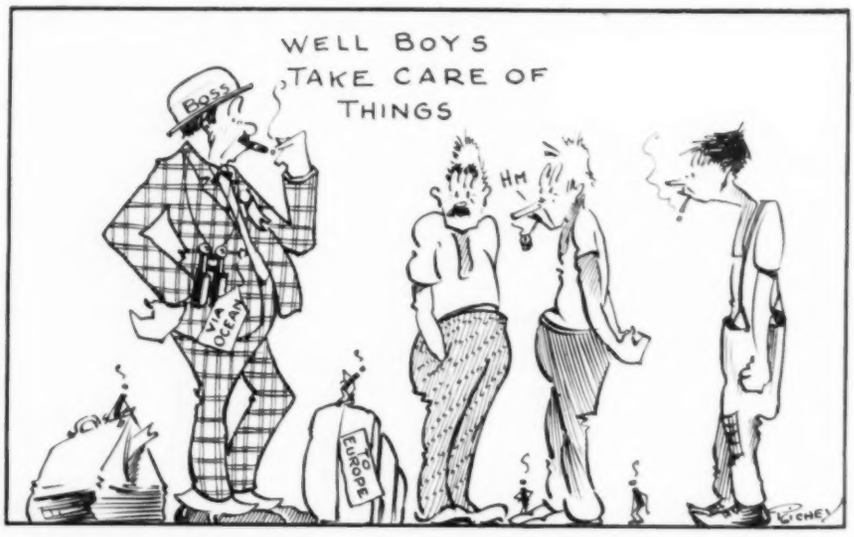
"Good old Carry. I should like to shake her by the hand. I never was much of a hand to read poetry of any kind, but there is one that got under my skin. I had to learn it one time for a school exercise, but when the time came to spout it from the platform the heart rending pathos of the words so affected me that I broke down. 'I never more shall see my own, my native land. Take a message and a token to some distant friends of mine, for I was born at Bingen—at Bingen on the Rhine.'

"He talked of his mother 'Her other sons shall comfort her old age' of his father and his father's sword 'And with boyish love I hung it where the bright light used to shine on the cottage wall at Bingen—calm Bingen on the Rhine.' 'Tell my sister not to weep for me and sob with drooping head, when the troops come marching home again with glad and gallant tread.'

" 'There's another—not a sister * * * I dreamed I stood with her and saw the yellow sunlight shine on the vine clad hills of Bingen—fair Bingen on the Rhine. I saw the blue Rhine sweep along, I heard or seemed to hear the German songs we used to sing in chorus sweet and clear * * * And her little hand lay lightly, confidingly in mine, but we'll meet no more at Bingen—loved Bingen on the Rhine.' "

Bill rose to go. "Go ahead" he said. "Laugh at the old sentimentalist."

I did not laugh. I remembered another innocent hearted boy who never came back to Bingen—to our Bingen on the Rhine.



Auf Wiedersehn. He's on his way to Bingen, to Bingen on the Rhine

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Casting Copper-Silicon Alloys

(*Concluded from page* 26)

possible by pouring rather hot and having high sprues either through the use of high copes or built-up sprues or pouring basins.

It is also quite important that generous fillets be used where the gates join the casting and where thin sections join heavier sections.

Inasmuch as copper-silicon alloys, when cast under proper conditions have a good surface, it is urged that small machining allowance be made wherever possible to take advantage, as is the case with all castings, of the hardest and soundest metal on the surface or skin.

In large castings where there is a long cooling period or in castings where it is impractical to feed all heavier sectioned bosses and lugs, chills are of benefit, particularly for castings subjected to pressure. The use of chills will help to secure progressive and uniform freezing toward the parts being fed.

The alloys should not be poured at a higher temperature than is necessary for the metal to run satisfactorily. Castings poured at too high a temperature are susceptible to several types of defects. The alloy of 95 per cent copper, 4 per cent silicon, 1 per cent manganese begins to freeze at approximately 1832 degrees Fahr. (1000 degrees Cent.). Large, heavy castings of this alloy are poured at about 1950 to 2050 degrees Fahr. and small, light-sectioned castings often are poured advantageously as high as 2250 degrees Fahr.

Skims Off Glass

The metal should be poured as slowly as is consistent with the running of the castings being made, especially in the case of large castings. The slower the pouring, the less liability there will be of scruff. For large castings, it is advisable to use a pouring basin.

Glass used as a cover during melting preferably is skimmed off before pouring. This is done best by thickening the glass with a handful of silica sand before trying to remove it with a skimmer bar.

Castings are sometimes sandblasted before and sometimes after the removal of sprues, gates, and risers. Sprue cutters and band saws are used in trimming small castings. Hack saws, manually operated or power driven, and pneumatic chisels are used for larger castings. The castings may also be wire-brushed, pickled, or water-tumbled. Considerable expense often can be saved by a study of the most suitable saws and other equipment used in cleaning.

Copper-silicon alloys are readily machinable where the correct procedure is followed, and a good lubricant is used. Where a refrigerant-base oil is employed, the work must not be allowed to stand around any longer than necessary after machining to avoid staining. Tools should be high-speed steel with cutting angle similar to that used on brass, except that turning tools should have slight top slope. Carboloy and chromium plated tools have also been used to advantage. The alloys can be machined at a speed equal to or higher than many alloys of less strength and inferior physical properties.

Welding Is Employed

The copper-silicon-manganese alloy is readily welded with rods or electrodes of copper-silicon-manganese alloy by oxy-acetylene and electric arc methods. This makes it possible to join the castings, by welding, to other fabricated parts. The welding properties have been used to advantage by foundrymen in salvaging what would otherwise have resulted in defective or rejected castings.

The copper-silicon-manganese alloy may be heat treated (annealed) at temperatures of approximately 1300 to 1350 degrees Fahr. and quenched to further toughen the metal, improve its machining qualities, remove casting strains from certain types of castings and increase the resistance to pressure.

The copper-silicon alloys are strong, tough, corrosion-resistant alloys having physical properties superior to the tin bronzes and possessing the fundamental corrosion resistance of pure copper.

The alloy of 95 per cent copper, 4 per cent silicon, 1 per cent manganese has approximate physical properties as given in Table I.

The copper-silicon alloys are nonrusting and offer excellent resistance to corrosion by a large number of normally corrosive solutions and compounds. However, similar to copper and all copper-base alloys, they are not equally resistant to all corroding agents or to the same corroding agent under all conditions. Corrosion may be particularly affected by the presence of oxidizing agents.

These alloys have been found of special value for resistance to atmospheric corrosion of all types in both industrial and marine locations and are also resistant to corrosion by sea water as well as corrosive industrial and natural waters, to sulphuric and hydrochloric acid and many of their salts, to alkalis and many of the alkali salts. Good resistance is shown to certain organic compounds including alcohol, phenol, cresol, sugar solutions, fatty acids and organic salts.

The strength and toughness of the copper-silicon alloys are used to good advantage in castings of the type shown in Fig. 2. Many castings requiring such qualities coupled with good corrosion resistance have been used in sewage disposal equipment, marine hardware, chemical process equipment and other locations. Fig. 6 shows a 16-inch gate valve weighing 2000 pounds made of a copper-silicon alloy. A wide variety of such valves have found extensive use in highly corrosive atmospheres and liquids.

Fig. 5 illustrates a copper-silicon alloy kettle such as used for industrial plants where a durable and corrosion-resistant metal is required. For making such a piece of equipment, good casting properties are essential. Fig. 4, showing a water wheel cast from a copper-silicon alloy, is another example of a casting requiring a metal which is cast readily and has good strength and corrosion resistance.

Figs. 2, 4, 5, 6 are indicative of the variety of uses to which the copper-silicon alloys are adapted. Some of the other applications include drain fittings, electrical conduit fittings, and transmission line connectors. The fluidity of the alloys has been used to good advantage in casting intricate centrifugal pumps.

The copper-silicon alloys may be expected to find greater use as the study and knowledge of their properties and service records become more widespread.

Chicago Chapter Wins Convention Contest

Prior to the American Foundrymen's association convention, held in Detroit, it was announced that an attendance contest would be held between chapters, the contest to be based on the number of chapter members in attendance and the distance of the chapter center from Detroit. Cards were issued and members were asked to deposit these in a place provided at the convention hall. Later, registration lists were checked so that the various chapters would not be penalized for those who did not deposit their attendance cards.

The result of this member-miles attendance contest was as follows: Chicago Chapter won first prize of $75; Birmingham, Ala., Chapter won second prize of $50, and the Philadelphia Chapter, third prize of $25. The total number of miles traveled by members to attend this convention was 187,010.

Steel Coils Cast in Iron Pot

(*Continued from page 27*)

wall, each coil making ten complete turns. The heavy steel or wrought iron pipe is ¾-inch inside diameter and 1¼-inch outside diameter. The side wall coil has an inlet near the bottom and an outlet about 5 inches from the top. The bottom coil has an inlet at one side and an outlet at the center of the bottom.

Heavy steel or wrought iron pipe will not melt or collapse in this particular casting. In fact in the side walls the metal will have to rise rapidly to prevent cold shuts. The best way to pour the casting is through a ring of pop gates ¼ x 3 inches spaced about 1 foot apart on the outside of the top rim so that the metal will fall clear between the coil and the outside wall of the mold. Poured in this manner the mold will fill rapidly and the stream of iron will not play directly on any part of the coil. In the ideal method the pipes should be tinned, but fairly satisfactory results will be secured by cleaning them thoroughly by sand-blasting and covering them with a thin coating of oil. Even with this precaution the metal will *cough* to some extent, therefore 8 or 10 risers should be provided on top of the rim and a certain amount of metal should be allowed to flow through these risers. An alternative method would be to carry the top of the pot to an extra height of 4 or 5 inches and then cut this extra metal off afterward.

Chaplets placed in the ordinary manner will not hold the coils properly in the bottom. Increase of temperature will expand the coils and cause them to move sideways, therefore they must be supported on chaplets that will move with them, or on strips of metal, as shown in Fig. 2. Also the supports must be close enough together to prevent the pipe from buckling either up or down. The side wall coil may be held by spikes driven in the side wall of the mold. Care is taken to see that the spikes are not in direct line under any of the gates.

The projecting ends of the coils are anchored firmly in the wall of the mold to prevent any lateral, or up or down movement. Clearance is provided on the outside of the end for the pipe to expand slightly in a straight line. If the pipe inlet or outlet is not held in a close print, it will move more or less and leave a gap in the mold wall through which the metal will leak. As a precautionary measure, anticipating leakage from any cause, it is advisable to shove a little waste about 6 inches into the pipe, fill the space between the waste and the end of the pipe with dry, sharp sand and place a little more waste in the end of the pipe for a cork.

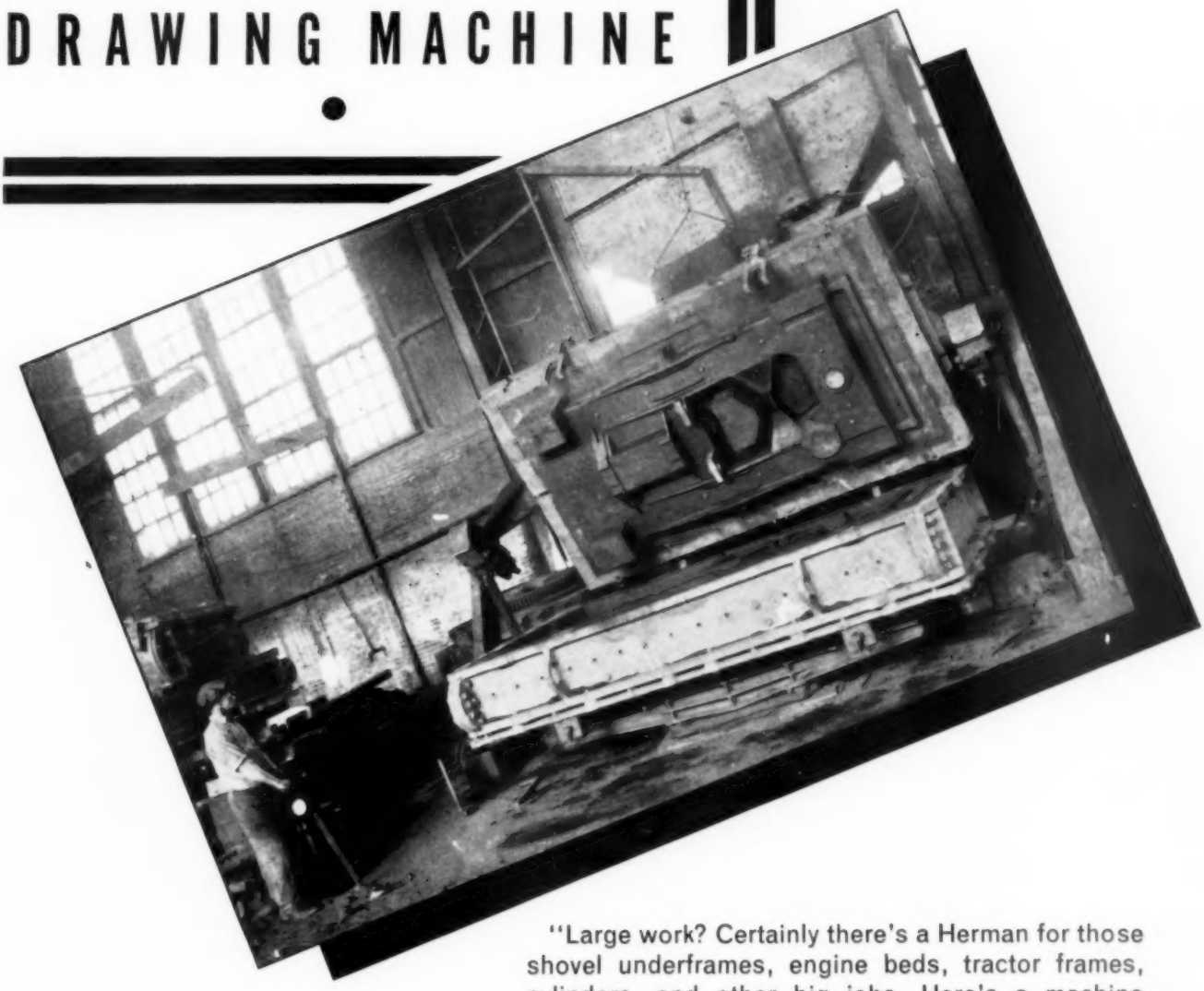
The mold is made in dry sand or loam according to any one of several available methods depending on equipment on hand, and to some extent, on the number of castings on order. Minimum equipment for a single casting would include an inside and outside sweep and a cope. The outside of the mold is formed in a hole in the floor, or in a flask. The inside part of the mold reinforced by an arbor or crab is suspended from the cope. In one method a cavity conforming to the shape of the inside of the pot is swept in the drag. The arbor is placed in this cavity and sand is rammed to the top of the mold. The cope then is adjusted in place and attached to the arbor by suitable bolts. The cope is rammed full of sand and when it is removed the arbor and sand for forming the inside of the pot come with it. A second sweep then is employed to remove a thickness of sand from the drag mold, corresponding to the thickness of the desired casting.

In a second method inside and outside of the mold are swept independently of each other. The drag or outside of the mold is swept full size in the first operation. If made in a flask it is placed in the oven to be dried. If made in the floor, a suitable fire, gas, charcoal or coke is placed on

(*Concluded on page 62*)

BOYS from many sections of the country won prizes in the apprentice contest judged at the recent annual meeting of the A.F.A. in Detroit. Above, reading from left to right, George Danfeldt, French & Hecht Inc., Davenport, Iowa, first prize in iron molding; Stanley Raskiewicz, Sivyer Steel Casting Co., Milwaukee, first in steel molding; John Wolk Jr., Falk Corp., Milwaukee, second in steel molding; John Bloomquist, John Deere Harvester Works, East Moline, Ill., a third in patternmaking. At right, from left to right, Russell L. Ashworth, Brown & Sharpe Mfg. Co., Providence, R. I., third in iron molding; I. E. Saks, United States Navy Yard, Philadelphia, third in steel molding. Other prize winners were shown in the June issue of THE FOUNDRY.

7′x12′ 26,000 LBS. CAPACITY JARR ROLLOVER AND PATTERN DRAWING MACHINE



"Large work? Certainly there's a Herman for those shovel underframes, engine beds, tractor frames, cylinders, and other big jobs. Here's a machine having a 7 ft. x 12 ft. rollover plate and a capacity of 26,000 pounds.

"Then, too, the jarring machine as on all Hermans may be used independently and has a jarring capacity of 46,000 lbs. at 80 lbs. air pressure.

"And these big ones roll over with the same smooth, steady action and give the same accurate draws as the small Hermans."

"It makes no difference to a Herman whether your work is large or small, it will make it better."

HERMAN PNEUMATIC MACHINE CO.
PITTSBURGH, PA.

(*Concluded from page* 60)

the inside and the mold is covered with light steel sheets. The core or inside part of the mold is swept on a plate and dried. The dried core is rolled over and lowered by suitable hooks into the drag where it rests on the chaplets on top of the coils. The rim of the pot is covered with cake cores. An empty cope is lowered into place and wedges are driven between the cores and the cope bars. Bolts are attached to the loops in the core and the upper ends of the bolts are secured with nuts and washers above the cope bars. While the coils of pipe and the chaplets support the cope readily at this stage, there is a possibility they might collapse when surrounded later by the molten metal. The cope then is rammed full of sand. The runners and risers are made up and the cope is weighted or bolted down if the mold is in the floor. Displacement of this particular casting, and consequently the weight required to hold the cope in place is approximately 18 tons, less 5 tons the approximate weight of cope and core.

Obituary

JOHN J. CARROLL, 75, president Gartland & Carroll Foundry Co., Sandusky, O., died in Providence hospital, Sandusky, June 26. Mr. Carroll was born in Rutland, Vt., July 24, 1861 and with his parents moved to Cleveland in 1865. At the age of 12 he entered the foundry and with the exception of a few seasons in the early eighties when he played professional baseball, he remained in the foundry industry continuously throughout his adult life. As a journeyman he worked for the National Malleable, the Eberhard and the Standard foundries in Cleveland. In 1896 he was appointed foundry superintendent of the National Malleable & Steel Castings Co., and retained that position until 1916 when he established the G. & C. Foundry Co., in Sandusky. Active in civic, social and business circles he served several terms as president of the local chamber of commerce and was director of the Third National bank. On his 74th birthday he was waited upon by district members of the Gray Iron Foundrymen's association and presented with felicitations and a cast plaque with an inscription testifying to the regard in which he was held.

♦ ♦ ♦

George W. Feaser, 70, for 27 years superintendent of the old Oliver Chilled Plow Works foundry, South Bend, Ind., died in that city June 30.

♦ ♦ ♦

Addison Gallien, 71, vice president, R. Hoe & Co., New York, printing press manufacturer, died recently at his home in Upper Montclair, N. J.

♦ ♦ ♦

Phillip Nelson, 72, died June 3. Mr. Nelson was foundry superintendent, the Nordberg Mfg. Co., Milwaukee, for 25 years and recently foundry superintendent, the Busch-Sulzer Diesel Engine Co., St. Louis.

♦ ♦ ♦

George C. Anderson, 63, secretary and general manager of the Cope-Swift Foundry Co., Detroit, died May 23 at Detroit. Mr. Anderson had been employed by the company for 48 years, started as an apprentice.

♦ ♦ ♦

Frank K. Berry, 66 years old, formerly president and general manager, A-B Stove Co., Battle Creek, Mich., of

John J. Carroll

which he was a co-founder, died in that city, June 28. Mr. Berry was an executive of the Marshall Furnace Co., Marshall, Mich., and on the board of directors of the A-B Stove Co.

♦ ♦ ♦

David Posey, 59, for the past ten years superintendent of the Alabama Foundry Co., Birmingham, Ala., subsidiary of the Standard Gas Equipment Co., Baltimore, died recently in Birmingham. He was born in Peekskill, N. Y., and for 45 years has been connected with the stove castings business.

♦ ♦ ♦

Dr. Lucius Pitkin, consulting chemist and an organizer of Lucius Pitkin Inc., New York, consulting chemists, chemical engineers and metallurgists, died in New York June 14. He was a member of the American Chemical society, the New York Microscopical society and the Chemists' club.

♦ ♦ ♦

Charles Forsberg, 65, foundry superintendent, Algoma Steel Corp., Sault Ste. Marie, Ontario, died suddenly June 16. Mr. Forsberg was born in Sweden, but as a boy came to the United States where he learned the molder's trade in Chicago and in the late nineties became foundry foreman in the plant of the Illinois Steel Co., South Chicago. For several years he was foundry superintendent for the Dominion Iron & Steel Co., Sydney, Nova Scotia. He joined the staff of the Algoma Steel Corp., in 1917.

♦ ♦ ♦

Benjamin J. Sibbitt, 59, president of the Ben Sibbitt Iron & Foundry Works, Wichita, Kans., died June 10 in Wichita. He had been a resident of the city since 1910 and was prominent in civic and business organizations. Mr. Sibbitt served as director of the chamber of commerce for six years, was a member of the Wichita Manufacturer's club, the American Foundrymen's association and the American Society for Metals. From 1908 to 1910 he was manager of the Vermilion Malleable Iron Co., Hoopeston, Ill.

♦ ♦ ♦

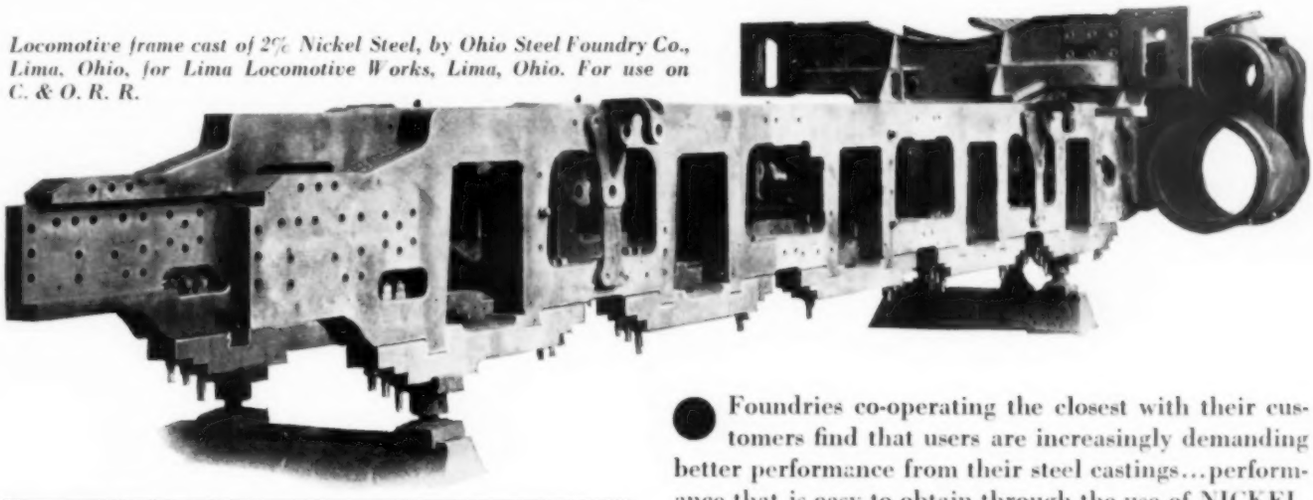
Lloyd Newcomb Allen, 76, Detroit representative of the Benton Harbor Malleable Industries Inc., Benton Harbor, Mich., the Muncie Malleable Foundry Co., Muncie, Ind., and the Fremont Foundry Co., Fremont, O., died June 12 at Detroit. He was born in Springport, N. Y., and attended Buchtel college, Akron, O. One of the most widely known foundrymen in the Middle West, Mr. Allen came to Michigan in the early 80's and joined the T. B. Rayl Co. and later owned the Allen Foundry Co. He sold this firm in 1893 and went to Cleveland in a sales capacity with Standard Foundry Co., later returning to Detroit.

♦ ♦ ♦

James A. Lanigan, 63, died June 19 in Cincinnati. He was born in Galt, Ont., but at an early age moved to Lawrence, Mass., where he served an apprenticeship with his uncle, the late James F. Lanigan, for many years dean of New England foundrymen and proprietor of the Davis Foundry. His first foreman's position was with a steel foundry in Everett, Mass. In 1908 he was appointed superintendent of the Whitney Iron Works, New Orleans. Several years later he joined the American Brake Shoe & Foundry Co., Chicago, and later was appointed general superintendent of all the company's eastern and southern foundries. In 1917 he designed, erected and operated two foundries at Barberton, O., specializing in the production of tire molds and cores for the rubber industry. Mr. Lanigan developed and introduced many important improvements in foundry methods and invented and patented several types of foundry equipment.

NICKEL STEEL CASTINGS
build foundry reputations!

Locomotive frame cast of 2% Nickel Steel, by Ohio Steel Foundry Co., Lima, Ohio, for Lima Locomotive Works, Lima, Ohio. For use on C. & O. R. R.



● Foundries co-operating the closest with their customers find that users are increasingly demanding better performance from their steel castings...performance that is easy to obtain through the use of NICKEL.

By using NICKEL, foundries not only establish themselves firmly with present customers, but attract a profitable volume of new business as well.

Aside from the excellent properties shown by the usual static tensile tests, Nickel Steel castings possess a greater resistance to impact and fatigue stresses...giving them additional factors of SAFETY.

Among the alloy steel casting compositions which have gained popularity are the low carbon and medium carbon 2% NICKEL Steels.

Low carbon 2% Nickel Steels:

This steel, which is covered by International Nickel Company Recommended Railroad Specification No. 6, has been found especially suited for locomotive frames, castings for mining, excavating and steel mill machinery, ship castings and other parts subjected to shock and fatigue stresses. The retention of impact resistance and ductility at low temperatures is another desirable characteristic of this steel, making it well adapted for locomotive and other machinery castings operated in cold climates.

Composition		*Recommended Heat Treatment*
Carbon, %	Max. 0.20	1725° F.—2 hours per inch thickness; air cool.
Manganese, %	0.60-0.90	
Silicon, %	Min. 0.15	1500-1550° F.—1½ hours per inch thickness; air cool.
Phosphorus, %	Under 0.045	
Sulphur, %	Under 0.05	1100-1250° F.—draw; cool in air or furnace.
Nickel, %	Min. 2.00	

Typical Test Results on Normalized and Drawn Low Carbon 2% Nickel Steels*

(Coupons cast and heat treated integrally with castings)

Composition, %						Yield Point, lbs./ sq. in.	Tensile Strength, lbs./ sq. in.	Elong. in 2", %	Red. Area, %
C	Mn	Si	P	S	Ni				
0.20	0.81	0.33	.011	.024	2.11	48,500	81,500	32.0	60.7
0.18	0.76	0.37	.015	.023	2.16	48,250	75,750	29.5	61.8
0.20	0.67	0.30	.011	.023	2.04	52,500	81,500	32.5	59.9
0.19	0.89	0.30	.012	.024	2.07	55,000	81,500	27.5	52.2
0.17	0.84	0.30	.012	.022	2.09	51,000	79,000	32.6	62.3
0.19	0.91	0.30	.012	.023	2.14	51,250	85,100	29.0	52.0

*These data obtained through the courtesy of the Canadian Steel Foundries, Montreal, P. Q., Canada.

Medium carbon 2% Nickel Steels:

This steel, covered by International Nickel Company Recommended Railroad Specification No. 4, is well adapted for miscellaneous railroad castings, ship castings, large gears not subjected to severe abrasion, steel mill machinery, crusher frames, tractor and power shovel frames, and many other parts demanding higher strength and elastic properties than those given by the lower carbon 2% nickel steels previously described.

Composition	
Carbon, %	0.20-0.30
Manganese, %	0.70-1.00
Silicon, %	0.25-0.40
Phosphorus, %	Under 0.05
Sulphur, %	Under 0.05
Nickel, %	Min. 2.00

Recommended Heat Treatment

Normalize 1650° F., Draw 1200° F.

Typical Test Results on Medium Carbon 2% Nickel Steels*

(Coupons cast and heat treated integrally with castings)

Composition, %					Yield Point, lbs. sq. in.	Tensile Strength, lbs. sq. in.	Elong. in 2", %	Red. Area, %
C	Mn	P	S	Ni				
0.28	0.97	.034	.040	1.99	62,300	94,700	26.5	48.4
0.28	1.00	.035	.045	2.16	60,750	97,100	26.5	53.6
0.27	0.91	.033	.047	1.98	57,150	94,350	25.5	47.5
0.30	1.05	.030	.071	1.95	63,550	104,550	25.0	54.8

*Courtesy of Adirondack Steel Foundries, Watervliet, N. Y.

ALLOY NICKEL STEELS

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

A. S. T. M. Holds Annual Meeting

(*Continued from page 28*)

ing of the photographic film or paper, and the intensifying screens. The factors of contrast, latitude speed and definition must be related properly to use the device to the best advantage. The x-ray source also contains several variable factors which the operator must adjust to obtain the best conditions for the particular problem. Not only must the image be intense enough to operate the detecting device, but it also must show the necessary variation in intensity to reveal the interior structure of the object.

Mr. Norton stated the question of sensitivity of the method is of considerable importance and to apply the method successfully the operator should know the size of the smallest detectable defect. Also, the question of shielding to protect the film from extraneous x-ray effects forms a vital part of the correct radiographic technique and must be worked out carefully in each specific case. Three types of installations are in use, namely the fixed, semiportable which may be moved about with a crane, and the portable.

Defect Size Determined

In reply to a question by Mr. Adams, the speaker stated that scattered radiation is present to a marked degree. While it may be several times the intensity of the direct radiation, only the direct radiation produces the desired contrast on the film. The time of exposure must be increased when the indirect radiation is taken out with a Bucky grid. Herbert R. Isenburger, St. John X-Ray Service, presented the results of tests illustrating the size of defect which may be determined. Mr. Lester emphasized the importance of the operator mastering the proper technique. He stated that various results may be obtained with different techniques.

Earnshaw Cook, American Brake Shoe & Foundry Co., Mahwah, N. J., discussed the practice and results obtained by five x-ray laboratories in a paper "Foundry Applications of Radiography." Those discussed were the Aluminum Co. of America, American Manganese Steel Co., Electro-Alloys Co., Rock Island Arsenal and the Watertown arsenal. Mr. Cook stated the more familiar imperfections readily interpreted from the films are shrinkage cavities, flocculent shrink, blow-holes from mold or metal gases, cracks, inclusions and pronounced dendritic formations. With close co-operation between engineering departments in modifying designs to attain better homogeneity and experiment with pilot castings in the foundry, Mr. Cook believes much can be accomplished. However, arbitrary specifications frequently impose hardships on the foundry and increase unnecessarily the ultimate cost to the consumer. Maintenance of adequate standards without expensive destructive tests was given as an outstanding advantage of radiographic inspection.

In summarizing the work of the five laboratories, Mr. Cook stated that the Aluminum Co. of America uses radiography primarily in the development of satisfactory casting or fabricating technique and to a comparatively small extent for the routine inspection of commercial products, as do the American Manganese Steel Co. and the Electro-Alloys Co. The unit at the Rock Island Arsenal is used strictly as an inspection tool. Manufacturers submit sample castings which are radiographed throughout. Complete reports are given to the producer for his guidance. The Watertown Arsenal combines both production and inspection routine as problems arise. The speaker also stressed the possible savings in machining costs through the application of the x-ray. A practical illustration of the use of radiography in a study of the best method of gating and risering a pilot casting was presented. Four methods were tried before finding the method eliminating the defect. The final method also resulted in a marked increase in the yield.

Mr. Lester presented a written discussion in which he stated that the x-ray is too expensive to be used as an inspection tool. In his opinion it should be used in the development of a casting technique which will be the means of making good castings, rather than as a means of rejection after the castings are made. In reply to a question of Victor Hicks, Mellon institute, Mr. Cook stated that defects in pilot castings will not necessarily be present in the full size castings. The first step in the process should be to see that defects in the full size casting occur in the pilot casting.

John Howe Hall, Taylor-Wharton Iron & Steel Co., questioned the need of x-ray equipment to examine the defects in a pilot casting such as discussed in the paper. He stated the composition was such that proper heat treatment would render it brittle and thus easily broken for complete study. Mr. Cook defended the use of the pilot casting and stated one shot with the x-ray would show all of the defects. Paul E. McKinney, Bethlehem Steel Co. expressed the belief that the x-ray is an excellent tool if properly used. He stated a committee of the American Foundrymen's association is studying the problem thoroughly.

Three papers featured the second session of the symposium on radiography, under the chairmanship of H. H. Lester, Watertown arsenal and with the following co-chairmen: J. T. Norton, Massachusetts Institute of Technology; C. W. Briggs, U. S. Navy gun factory; and R. A. Bull, consultant, Chicago.

Supplies Permanent Record

Herman E. Seeman, Eastman Kodak Co., Rochester, N. Y., offered a nontechnical discussion of radiography which involves the printing of negatives either with x-ray or radioactive material, such as radium. Fluoroscopy, applicable only to x-ray permits the viewing of a shadow image on a chemical screen which gives off light. Radiography permits finer detail, and a permanent record of the image observed. The use of these methods on studying assemblies and its application to a wide range of materials from metals to

(*Continued on page 67*)

New Officers

THE following officers were elected at the opening session of the annual meeting of the A.S.T.M. in Atlantic City, June 30:

President

A. C. Fieldner, Chief engineer, experiment stations division, bureau of mines, Washington.

Vice President

T. G. Delbridge, manager of research and development department, Atlantic Refining Co., Philadelphia.

Executive Committee

O. U. Cook, inspecting engineer, Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.

H. F. Gonnerman, manager, research laboratory, Portland Cement association, Chicago.

C. S. Reeve, manager, research development, Barrett Co., Leonia, N. J.

F. E. Richart, research professor of engineering materials, University of Illinois, Urbana, Ill.

F. M. Waring, engineer of tests, Pennsylvania railroad, Altoona, Pa.

The executive committee announced that the society's fortieth annual meeting will be held at the Waldorf-Astoria hotel, New York, June 28-July 2, 1937.

(*Continued from page 64*)

coal, textiles, food, wood and miscellaneous materials was sketched.

Norman L. Mochel, Westinghouse Electric and Manufacturing Co., Philadelphia, one of the pioneers on radiography, discussed the varied fields of x-ray and gamma ray investigations, the latter covering the use of radioactive substances as a light source. The latter is not an alternative, but a supplementary procedure, and available where deeper penetration, the application to locations impossible to reach by x-ray, or where field tests require portability of equipment. He traced the history of the development of each method, gave examples of comparative results, and a mass of detailed data on uses. The technique of the gamma ray method was explained, with the use of special film holders, with a lead backing material and special screens which intensify and decrease the time for recording the image upon films. The gamma ray method is slower and varies with the quantity of the substance, usually radium sulphate, which is employed.

Comments on Decrease in Price

The author gave a list of the available sources of radioactive salts and commented upon the decrease in price from $180 a milligram in 1912 to $70 in 1920 and the present price of $55. Valuable amounts of the material, encased in holders, protected in containers for handling to prevent the emanation of the rays so harmful to operators and other detailed information of value to users were presented. The material may be rented at $10 per 100 milligrams for each 24-hour period. An example showing the time required gave an instance of a complex valve body casting upon which multiple exposures required three weeks of 24 hour exposures to give the requisite information. The penetration of x-rays was given at 4½ inches of steel at present, but electrical advances, involving higher voltages, promise to extend this effectiveness. Gamma ray investigations have been made through 6 inches of steel and even lead is penetrated by this ray. In the discussion, V. T. Malcolm, Chapman Valve Mfg. Co., Indian Orchard, Mass., questioned whether proper interpretation of negatives can be had. He stressed the unfortunate position of the manufacturer who is expected to meet radiographic tests when agreement upon disclosures of such tests has not been reached.

The same unstable condition was reflected in a study of the problems of radiographic specifications presented by H. H. Lester. In response to extensive questionnaires sent to producers and consumers of cast and welded metal structures a wide divergence of opinion was developed. Such tests still are new, probably more familiar and easier of application to welds than to complete castings. The high cost, technical limitations, lack of facilities and the absence of data to tie in the effect of faults discerned through radiography with definite proof of service limitations cloud the possibility of early development of specifications.

ADVERTISING PAGES REMOVED

According to Dr. Lester, the applications of such test methods cover castings or welds that must withstand high stress or temperature; structural units which may not be stressed highly, but where failure in service will cause damage far in excess of the value of the unit; and structural units of low stress, but in which machining costs that may disclose hidden defects indicate the value of non-destructive tests applied before machining.

Lack of uniformity in test methods, variance in interpretation and the apportionment of the cost of testing were mentioned. The speaker recommended the use of radiography in development of casting technique wherever such castings are to be subjected to radiographic tests. He urged the use of x-ray equipment by foundries while acknowledging that the cost of installation and operation of such equipment is prohibitive except in the case of a few establishments. As for specifications for such tests, the speaker recommended the co-operation of producers and consumers in casting procedure, although admitting that such was a makeshift program. It was stated that the time is not yet at hand for writing a method for interpreting films and no agreement exists upon the kind or extent of defects shown which require rejection, except as by determination of the inspector.

The practice of making pilot castings to be tested at the consumers establishment, then referred back to the foundry with recommendations for altering production practice was described as clumsy, expensive, time consuming and not satisfactory.

Results obtained through the application of diffraction methods in laboratory work were discussed by speakers at the third and fourth sessions devoted to the symposium on "Radiography and X-Ray Diffraction Methods." The discussions were concerned mainly with the application of the method to samples of materials which had been cold worked.

Descriptions of installations and x-ray diffraction methods suited to the applications discussed in the symposium were presented by Charles S. Barrett, Carnegie Institute of Technology, Pittsburgh. The speaker described installations at the research laboratory of the Aluminum Co. of America and the Massachusetts Institute of Technology, and discussed ways to reduce the cost of installations. He also described briefly the various types of diffraction apparatus which may be purchased on the market, and discussed the use of a new zinc sulphide screen in diffraction work.

Aging of Alloys Discussed

Mr. Barrett stated that x-ray diffraction is useful in the study of age hardening of supersaturated alloys. Ordinarily the dimensions of the solvent lattice change during aging in a way that reveals definitely the amount of precipitation that has occurred at any stage of the aging process. In several cases, such as aluminum-rich aluminum-magnesium alloys, precipitation occurs locally and may be overlooked unless the x-ray diffraction method is used in conjunction with others.

In a paper "Constitution of Alloys", Kent R. Van Horn, Aluminum Co. of America, Cleveland, stated that x-ray diffraction effects are a definite test of crystalline entity and can identify positively intermediate alloy phases. Small solid or powder samples can be examined. Small specimens can be produced with a

Malleable Committee

REPORT of the committee A-7 on malleable iron castings, presented at the Thursday session of the annual convention of the American Society for Testing Materials, announced that the following new officers of the committee have been elected for 1936-37: Chairman, E. K. Smith, Electro Metallurgical Co., Detroit; vice chairman, H. W. Faus, New York Central Lines, New York; secretary, H. A. Schwartz, National Malleable & Steel Castings Co., Cleveland; and members of the advisory committee in addition to the officers, W. P. Putnam, Detroit Testing Laboratory, and Enrique Touceda, Malleable Iron Research institute, Albany, N. Y.

The report also announced that the following new members have been added to the committee: H. M. Boylston, Case School of Applied Science, Cleveland; J. M. G. Fullman, National Electrical Products Corp., Ambridge, Pa.; R. G. McElwee, Vanadium Corp. of America, Detroit; E. R. Torgler, S. R. Dresser Mfg. Co., Bradford, Conn.; R. A. Corley, Corley Co., and A. M. Houser, A. S. A. sectional committee on pipe flanges and fittings.

high degree of uniformity in composition, require relatively short periods of time for homogenization and may be quenched rapidly to retain the unstable high temperature phase. The x-ray method can be adapted easily for investigation of test specimens.

In an interesting discussion on "Chemical Analysis By X-Ray Diffraction Methods", Wheeler P. Davey, Pennsylvania State College, State College, Pa., stated that the x-ray diffraction data, especially that obtained by the so-called power method or one of its simple variants, often are useful in the identification of crystalline or semicrystalline materials. Specific advantages are as follows: Quantity needed for test is small; analysis can be made without destruction or change of the material; the state of chemical combination can be determined; the course of a chemical reaction may be followed.

Mr. Davey discussed a number of applications including the identification of a material in terms of some standard of known chemical composition; identification of the components in a mixture; identification of phases of a chemically known homogeneous material, and determination of the course of a chemical reaction. Industrial examples were given.

Measuring Method Important

A paper by G. Harvey Cameron, Hamilton College, Clinton, N. Y., and A. L. Patterson, Massachusetts Institute of Technology, Cambridge, Mass., stated that although the x-ray method of measuring particle size still is in the process of development, it is of great importance to science and industry because it offers the only possibility at present of distinguishing between the ultimate crystals and the aggregates. The method is based on the powder diffraction method and is applicable to particles from approximately 0.001 centimeters in diameter down to the smallest which show evidence of crystal structure.

Corrosion and the effect of temperature and creep provided a dual theme for the session Wednesday morning. F. F. Farnsworth, Bell Telephone Laboratories, chairman of the committee on the corrosion of iron and steel, reviewed the accomplishments during the past 20 years. At that time the first exposure tests of black sheets were made. Ten years ago, the first galvanized tests of wires, sheet and hardware were inaugurated. Since its establishment the committee has expended about $100,000 and many vital principles of behavior of iron and steel under long time corrosion have been established. The committee proposed as a tentative method of test, the Preece test, which employes a solution of copper sulphate to determine the uniformity of zinc coating. A subcommittee under chairmanship of L. W. Hopkins, American Chain Co., reported progress on methods for determining the weight and uniformity of zinc coatings on hardware and irregularly shaped articles. T. S. Fuller, General Electric Co., Schenectady, reported on the progress of corrosion tests applied to nonferrous metals.

A joint committee of A. S. T. M., National Bureau of Standards and the American Electroplaters' society, under chairmanship of William Blum of the bureau has been organized to carry on exposure tests of plating on nonferrous metals.

Reporting for the committee on iron, chromium, nickel and related alloys, Chairman Jerome Strauss, Vanadium Corp., Bridgeville, Pa., announced the presentation of seven new tentative specifications approved by committee E-10 on standards.

The report of the joint research committee of A. S. T. M. and the American Society of Mechanical Engineers was presented by H. J. French, International Nickel Co., New York, who announced the donation of about $11,000 for research at Battelle Memorial institute now in progress on the effect of temperature on properties of metals. R. Sergeson, Republic Steel Co., gave the results of a study of low temperature impact testing of 0.35 per cent carbon steel. Various types of tests under temperatures ranging as low as —50 degrees Fahr. and with various types of notched specimens have been made for the purpose of establishing test procedure. A second paper presented in connection with the joint committee's report was given by Howard Cross, Battelle institute, and covering 18 and 8 chrome-nickel steel and 0.35 per cent carbon steel showed that long time creep test data fail to support the assumption that rate of creep may be extrapolated from that determined at the end of 1000 hours. The extent of strain-hardening temperature range must also be considered before design assumptions can be made.

Results of Notched Bar Tests

H. F. Moore, University of Illinois, Urbana, Ill., presented the results of slow bend and impact tests of notched bars at low temperatures. These studies were made jointly with H. B. Wishart and S. W. Lyon of the university. Tests were conducted from ordinary room temperature to 40 degrees below zero, Fahr.

A new type of direct load creep test machine, involving the use of a convection type small heating furnace was explained by J. J. Curran, Walworth Co., Boston.

A paper by A. E. White and C. L. Clark, University of Michigan, Ann Arbor, Mich., and R. L. Wilson, Timken Steel & Tube Co., Canton, O., described long time creep tests at 1000 degrees Fahr. on an electric furnace steel of carbon 0.15 and manganese 0.50. The investigation showed that carbon steel loses ductility after prolonged heating under stress and a metallurgical investigation gave a new theory of the action encountered. Under test, spheroidization began after about 4000 hours. After 13,950 hours not only spheroidization, but migration of carbide particles was noted. The fracture of creep specimens was intercrystalline while that of short time tension specimens was transcrystalline. Creep specimens showed no evidence of strain hardening encountered in short time specimens and the percentage of reduction in area and elongation were markedly reduced. The difference in the latter with a standard test specimen was 42.5 per cent elongation in 2 inches in the short tensile test to fracture, while in a simpler specimen subjected to creep test load of 6000 pounds at 1000 degrees Fahr. for 13,950 hours, the elongation was 11.0 per cent.

Impact Tests Necessary

High velocity impact testing presented in a paper by H. C. Mann, Watertown arsenal, Watertown, Mass., was greeted by H. F. Moore, University of Illinois, Urbana, Ill., as true pioneering investigation into the little known field of kinematic stress and strength of materials at the Wednesday night session. Dr. Mann presented data which show that high velocity impact tests are necessary to show the true dynamic properties of materials. He established a transition velocity within which the material reacts as normally expected. Above this velocity factor which is measurable and therefore useful in design, dynamic properties are encountered to show that previously used total energy values give no indication of serviceability. A material may show a high energy value, yet have a low transition velocity which would unfit it for service where dynamic loading is encountered. Behavior of metals under high velocity impact, important in the design of railway and automotive equipment may be studied more closely by this type of test. A new impact testing machine, employing a specimen tested under tension impact and capable of producing velocities up to 1000 feet per second has been built by the arsenal. It consists of a pendulum for measuring the energy required to rupture the specimen and a rotatable wheel with retractable, horn-type, striking hammers. The pendulum which measures

(*Continued on page 70*)

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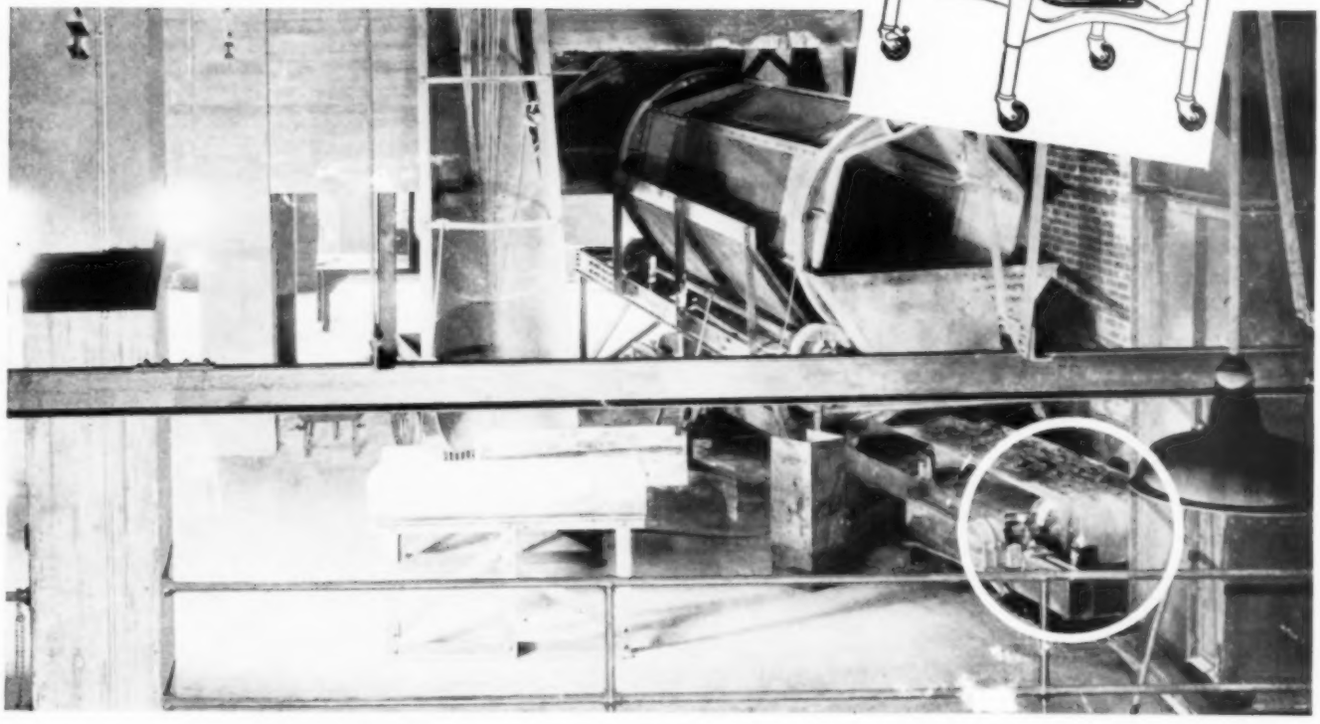

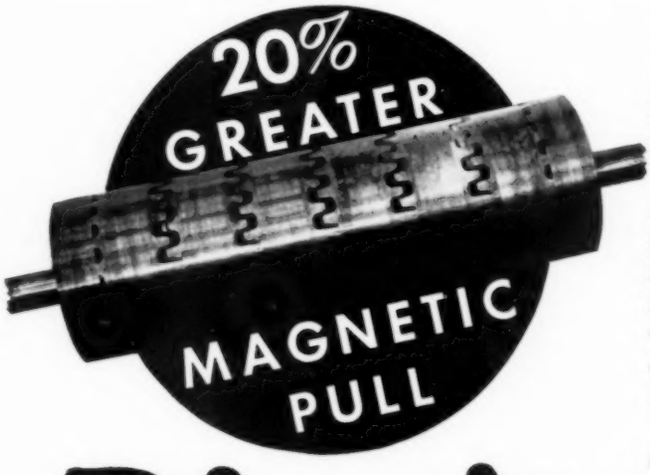

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You can't make fine castings with iron salted foundry sand. Risers and gaggers can be screened out but there is only one way to remove shot iron and fine stuff—a Dings High Intensity Magnetic Separator. Dings Magnetic Pulley Type Separators are 20% stronger than any other similar unit on the market. They are cool running, consume little current and assure maximum sand cleaning ability.

If you are re-using your sand without running it over a separator or are using another make or type of separator send us a sample and let us demonstrate how much iron there is in it. There will be no charge or obligation incurred.

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Separation Headquarters since 1899

(*Continued from page* 68)
the energy is normally at rest, but when the test piece is struck, the blow is imparted to and measured by the pendulum swing.

Problems of chemical analysis, spectographic determination of quantities of various substances viewed either by the arc or spark method, and various new developments in mechanical testing were presented. G. E. F. Lundell, bureau of standards, Washington, chairman of the committee on chemical analysis of metals, announced the preparation of revised and improved chemical methods for analyzing steel, cast iron, open hearth and wrought iron which will include procedures for determining carbon, manganese, phosphorus, sulphur, silicon, copper, nickel, chromium, vanadium, molybdenum, titanium and tungsten. These will supersede present methods.

The report of H. V. Churchill, Aluminum Co. of America, New Kensington, Pa., chairman of the committee on spectographic analysis, and a paper by W. R. Koch, U. S. army air corps, Dayton, O., and O. S. Duffendack, University of Michigan, Ann Arbor, Mich., indicated progress toward indicating quantities of materials present either as metallic alloys or in solutions.

The report of the committee on methods of testing given by W. H. Fulweiler, United Gas Improvement Co., Philadelphia, chairman of the general committee, gave the first indication of the approaching study of temperature and humidity effects upon the properties of materials. The consideration of a standard atmospheric condition is indicated. Slight changes in tentative specifications for verification of testing machines, Rockwell hardness testing of metals, elastic strength of materials and testing screens were approved.

Report on Cast Iron

The research committee on fatigue of metals under H. F. Moore is inquiring into x-ray diffraction as a means to detect incipient creep or plastic slip. Detection of small surface cracks by use of solutions and the application of ultraviolet light, and magnetic and audiophonic means are being studied.

Report of committee A-3 on cast iron, presented by H. Bornstein, Deere & Co., Moline, Ill., chairman, at the iron and steel session recommended that the proposed tentative specifications for light weight and thin section gray iron castings be accepted for publication by the society as tentative; that tentative specifications for gray iron castings (A 48-35T), with certain editorial changes, be referred to the society for adoption as standard; and that the standard specifications for chilled cast iron wheels (A 46-24) be withdrawn as standard, due to the fact that they have been superseded by existing tentative specifications for chilled tread cast iron wheels (A 46-30T). The report of the committee was adopted.

H. A. Schwartz, National Malleable & Steel Castings Co., Cleveland, and the new secretary of committee A-7 on malleable iron castings, reported that the subcommittee III, with R. E. Bryant as chairman, has prepared a tentative specification for cupola malleable iron which will be presented to committee E-10 for adoption and publication as tentative standard.

It also was stated that at the Detroit meeting in 1935, the committee adopted the following definition of malleable cast iron: "Malleable cast iron, white as cast, which has been made malleable by heat treating sufficiently to convert substantially all of the combined carbon to temper carbon." At the Pittsburgh meeting of the committee in March, 1936 the following definition of pearlitic malleable iron was recommended: "Any material which starts out as white cast iron free from any significant amount of primary graphite and subsequently is graphitized through heat treatment, is called pearlitic malleable, if the graphitization be purposely terminated when sufficient combined carbon, irrespective of form, remains to significantly affect the properties of the product."

Recommendations Are Made

The report of committee A-6 on magnetic properties, presented by Thomas Spooner, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., chairman, recommended that tentative definitions of terms, with units and symbols, relating to magnetic testing (A 127-35T) be referred to the society for adoption as standard to replace the present standard definitions (A 127-34). The committee also recommended that in the standard methods of test for magnetic properties of iron and steel (A 34-33), the induction for core loss tests be 15 kilogausses instead of 14 kilogausses. The report of the committee was adopted.

An exceptionally voluminous report of the work of committee A-1 on steel was presented by Mr. Morgan, chairman of the committee. The report first reviewed recommendations made to the society after the 1935 annual meeting concerning tentative standards and revisions approved. The committee recommended that a number of proposed specifications dealing with rolled products be accepted for publication as tentative.

Revisions were proposed for the tentative specifications for carbon steel castings for miscellaneous industrial uses, the specifications to continue as tentative standards: The committee also recommended that 14 tentative standards be referred to the society for adoption as standard and that revisions previously published as tentative in a number of standards be approved by the society as standard.

Withdrawal of nine standards was recommended including the following: Carbon steel castings (A 27-24).

H. S. Rawdon, bureau of standards, Washington, and chairman of the joint committee on the investigation of the effect of phosphorus and sulphur in steel presented a report of the work which has been accomplished by that committee since its organization some years ago. Because the committee feels that its work has been completed, and the sponsoring bodies are agreeable, the committee disbanded with the presentation of the report.

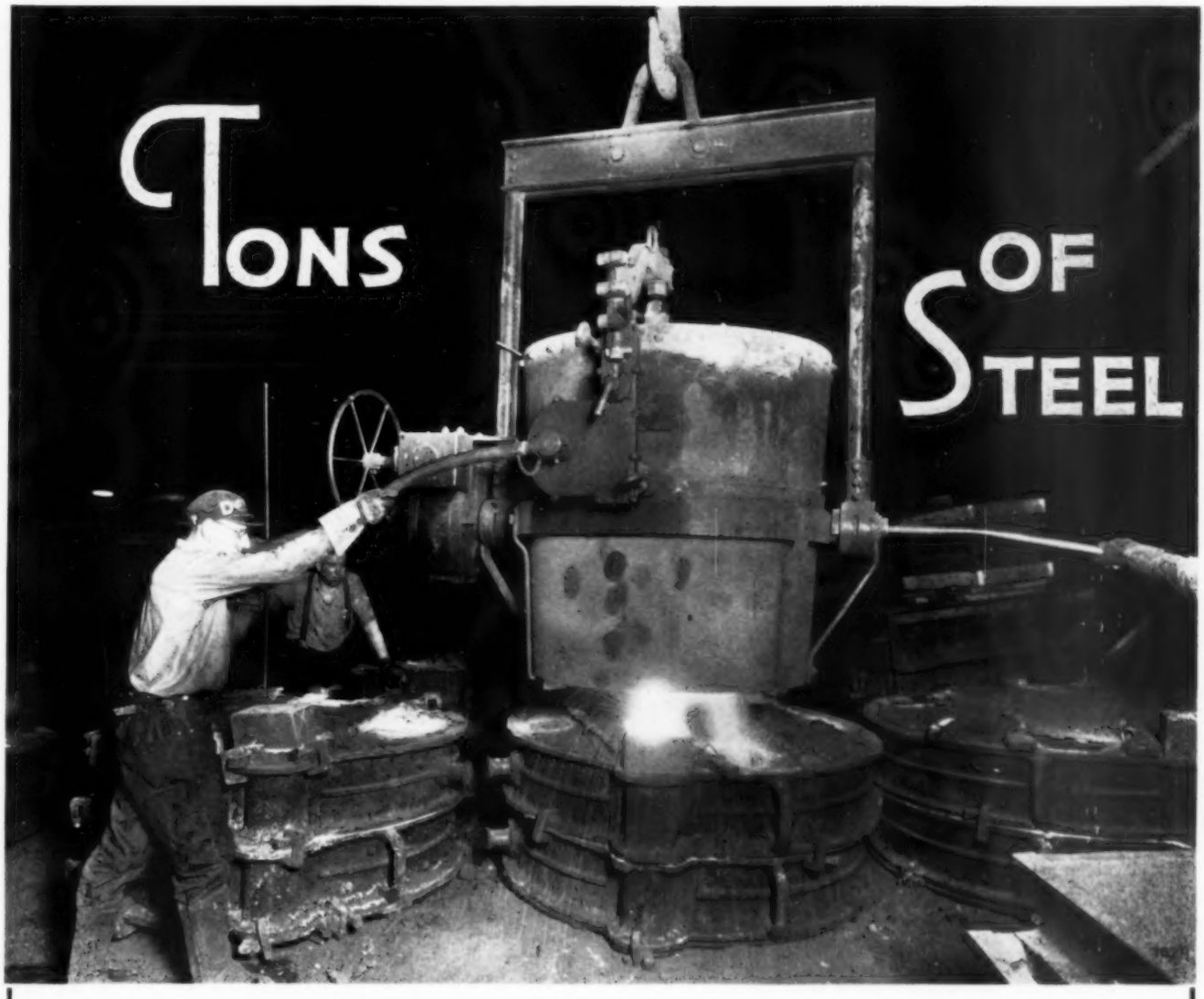
Reports of committees, presentation of several papers dealing with the testing of copper wire featured the session on nonferrous metals and metallography on Friday morning, under the chairmanship of J. R. Townsend, Bell Telephone laboratories, New York.

The report of committee B-5 on copper alloys, cast and wrought, presented by C. H. Mathewson, Yale university, New Haven, Conn., chairman, proposed five tentative specifications, including tentative specifications for bronze castings for turntables and movable bridges; proposed tentative specifications for bronze castings in the rough for locomotive wearing parts; and proposed tentative specifications for car and tender journal bearings, lined. The report also recommended the immediate adoption as standard of revision in the standard specifications for steam or valve bronze sand castings (B61-28), and standard specifications for aluminum bronze castings (B59-28). Tentative revisions also are recommended in standard specification for manganese bronze ingots for sand castings (B7-27) and standard specifications for manganese bronze sand castings (B54-33). The committee recommended that tentative specifications for copper-base alloys in ingot form for sand castings (B30-32T) be adopted as standards.

Casting Specifications Revised

Tentative revisions in standard specification for sand castings of the alloy: Copper, 88 per cent; tin, 8 per cent; zinc, 4 per cent (B60-28); steam or valve bronze sand castings (B61-28); and composition brass or ounce metal sand castings (B62-28) were recommended for adoption as standard. It was recommended that the following standard specifications be withdrawn: Bronze bearing metals for turntables and movable

(*Concluded on page* 72)



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(*Concluded from page 70*)
railroad bridges (B22-31) bronze castings in the rough for locomotive bearing parts (B66-28) and car and tender journal bearings lined, (B67-28).

Committee E-4 on metallography, in a report presented by C. H. Davis, American Brass Co., Waterbury, Conn., proposed a revision of standard rules governing the preparation of micrographs of metals and alloys, including recommended practice for photography as applied to metallography (E 2-30) and the adoption of tentative recommended practice for metallographic testing of ferrous and nonferrous metals (E3-35T) as standard.

The session on nonferrous metals was continued Friday afternoon, with C. H. Mathewson, Yale university, New Haven, Conn., as chairman. The report of committee B-7 on light metals and alloys, cast and wrought, presented by Sam Tour, Lucius Pitkin Inc., New York, carried a recommended proposed tentative specification for magnesium-base alloy bars, rods and shapes. Revisions in a number of tentative standards also were proposed including the following: Magnesium-base alloy castings (B80-34T); magnesium ingot and stick for remelting (B92-33T); and magnesium-base alloy ingot for remelting (B93-34T).

Activities of the various subcommittees of committee B-6 on die cast metals and alloys were outlined in a report presented by J. R. Townsend, Bell Telephone laboratories, New York, chairman. The report also included a paper on "Finishing of Die Castings," by J. C. Fox, Doehler Die Casting Co., Toledo, O. Mr. Fox discussed the following methods of surface finishing in connection with zinc-base alloy die castings: Electroplating, organic finishes, including enameling. Polishing, acid-dip treatment, enameling and japanning, and anodic oxidation treatment were discussed in connection with aluminum-base alloy die castings.

A brief report of the activities of committee B-2 on nonferrous metals and alloys was presented by E. E. Thum, *Metal Progress*, secretary. A plan of reorganization involves the abandonment of all former subcommittees and the organization of certain new committees.

Produces Steel Turbine Casings

(*Concluded from page 32*)
through the gate connected to the feeder *E*1, Fig. 28. When the metal in the mold reaches approximately the level of the base in the head *E*2, the second nozzle is opened and the steel enters through the gate attached to the head *E*2. Following this No. 1 nozzle is closed and pouring is continued through the second nozzle until the steel enters the base of the heads *E*3. The second nozzle moves to a position directly over each of the heads *E*3 where a supply of hot metal is poured directly into each head in turn.

By attaching the sprues to the lower feeders it is readily seen that apart from the feeders to some extent the heat gradient is equalized throughout the casting. Also the continuous flow of steel through the heads heats the surrounding sand and thus helps to keep the steel in these heads in a fluid condition until they have fulfilled their function.

In the second alternative method as illustrated in Fig. 31, the design produces a satisfactory casting without the addition of special feeding strips. The mold is made with the main flange joint on top thus making it possible to attach the feeders directly to the thick sections.

The drag of this mold is rolled over. During the ramming operation suitable pieces of steel are adjusted in place on the outside faces of the projecting bosses and brackets *E*4, 5, 6, 7 and 8, Fig. 30. These external chills extract the heat rapidly and thus help to equalize the cooling speed. When the sand is rammed to the level of the large flange *C*, Fig. 29, this part of the pattern is removed. The face of the cavity is painted with silica and the opening is covered with flat cores. The remainder of the molding operations are carried out in the usual manner.

Coremaking practice is similar to that described previously. The large core *D* is divided on the line marked *E*. Strong hooks are attached to the reinforcing steel frame work of cores *E* and *G* and the cores are suspended from the cope instead of resting on chaplets on the bottom. Chaplets supporting the cores temporarily are removed by attached pieces of wire.

A ladle with two nozzles is employed for pouring the steel. These are opened over sprues connected with the bottom heads as shown at *K*, Figs. 30 and 31. The steel is allowed to flow from both nozzles until it appears in the top heads *M*. The ladle then is moved and the stream enters these heads direct until they are filled.

Great Lakes Exposition

(*Concluded from page 29*)
devoted to a reproduction of a single floor of a jobbing foundry doing floor work, as shown in the illustration beginning of this article.

Castings play an important part in this exposition. A large percentage of materials exhibited are constructed at least in part with castings, and castings are used extensively in machines employed in manufacturing processes featured.

Exhibiting companies showing products in which castings from their own foundries are used, and exhibiting firms producing equipment and supplies employed in foundry operations, are included in the following:

AUTOMOTIVE BUILDING—Buick Motor Co., Flint, Mich.; Cadillac Motor Car Co., Detroit; Chevrolet Motor Co. Flint, Mich.; Chrysler Corp., Detroit; Delco Frigidaire Conditioning Corp., Dayton, O.; Ford Motor Co., Detroit; General Motors Corp., Detroit; Olds Motor Works, Lansing, Mich.; Pontiac Motor Co., Pontiac, Mich.; Studebaker Corp., South Bend, Ind.; and Thompson Products Inc., Cleveland.

HALL OF PROGESS—Apex Electric Co., Cleveland; General Electric Co., Schenectady, N. Y.; Hoover Co., Canton, O.; Iron Fireman Mfg. Co., Cleveland; Otis Elevator Co., Buffalo, N. Y.; Sears, Roebuck & Co., Chicago; and Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LAKESIDE EXHIBITION HALL—American Rolling Mill Co., Middletown, O.; American Ship Building Co., Cleveland; Association of Manufacturers of Chilled Car Wheels, Chicago; Cleveland Co-operative Stove Co., Cleveland; Cleveland Cliffs Iron Co., Cleveland; Dougherty Lumber Co., Cleveland; Forest City Foundries Co., Cleveland; Grasselli Chemical Co., Cleveland; Great Lakes Steel Corp., Detroit; Harris-Seybold-Potter Co., Dayton, O.; Henry Furnace & Foundry Co., Cleveland; Interlake Iron Co., Chicago; International Business Machines Co., Endicott, N. Y.; International Nickel Co., New York; Lake Superior Ore Institute, Cleveland; National Cash Register Co., Dayton, O.; National Malleable & Steel Castings Co., Cleveland; National Pressure Cooker Co., Eau Claire, Wis.; National Steel Corp., Ecorse, Mich.; Osborn Mfg. Co., Cleveland; Penton Publishing Co., Cleveland; Republic Steel Corp., Cleveland; Safety Clothing Co., Cleveland; Superior Die Casting Co., Cleveland; Timken Roller Bearing Co., Canton, O.; W. S. Tyler Co., Cleveland; U. S. Steel Corp., New York; and Youngstown Sheet & Tube Corp., Youngstown, O.

MISCELLANEOUS — Otis Steel Co., Cleveland; and Firestone Tire & Rubber Co., Akron, O.

French Foundry Meeting Is Postponed

The French foundry convention, organized by the Association Technique de Fonderie, which was to have taken place at Lille from June 25 to 28 has been postponed until a later date due to the disturbed conditions caused by recent strikes.

ADVERTISING PAGES REMOVED

Foundry Good Housekeeping

(*Concluded from page* 23)

these particles moving to the collecting medium. All piping should be checked to make sure there are no holes and also that it is of proper size and design. Considerable maintenance expense can be avoided by making a systematic check of dust collecting systems every month. An effective way is to make some one individual responsible for this task.

Natural ventilation is the cheapest item of cost in foundry operation and unfortunately, sometimes the least used. Anyone can appreciate how hard it is to keep operating equipment on monitor sash in working order. However, this is one of the first jobs to be done and the results which can be obtained are worth the expenditures. We suggest the plant engineers prepare a wind chart. Then the responsibility of seeing that the directions are followed so the maximum results can be obtained should be given to one individual.

System Requires Planning

Maintaining an efficient exhaust system is not an easy problem. It is almost impossible to design a system with the idea of later on increasing its capacity by addition of more branch pipes to the main line or header. That procedure will decrease the volume of air in other branch pipes. Increased power requirements unbalance the system with a tendency to overload the fan. Such systems will consume considerably more power than if properly designed.

It also should be remembered that the removal of outlets from the header line is fully as detrimental to the exhaust system as the addition of new branches and should be avoided as much as possible since it reduces the velocity and volume in the main header in the same manner as closing the damper. Dampers in individual branches usually are detrimental to properly designed exhaust systems. When each outlet is equipped with a damper and when several of them are closed while the system is in operation, air velocities will be reduced in the trunk lines to such an extent that dust carried in the air stream will be trapped in the header line, thus tending to block the system. For that reason it would seem that all exhaust systems should be designed to operate at full capacity at all times.

There are many other things which govern the design of an exhaust system. Resistance of material to be exhausted should be determined, if possible, to proportion properly the vertical exhaust pipe. Long pipe lines should be avoided wherever possible. Cleanout holes should be provided in header pipes and so located as to give ready access for cleaning. In the past, perhaps many have considered exhaust ventilation a tinsmith's job rather than an engineering one.

Central shakeouts are being given considerable study. It is probable that within the next year considerable progress will be made in overcoming that difficult problem.

Tumbling barrels are being improved steadily but the author believes users profitably can give that particular operation considerable attention. Some progress might be made if more thought were given to reducing our milling time. Traps for catching the heavier particles are provided and it is important, for many reasons, that they be kept in good repair so they can perform the services for which they are intended. It is interesting to note how many times we find the trip on the trap so loaded with weight that it is impossible for the trap to trip when it has reached its limit of capacity. In some types of mills when these traps are allowed to overload, the dust works up through the felt washers and eventually into the mill bearings.

Safety Measures Provided

A large number of foundries today furnish respirators for men to be used while they are chipping on castings which have not been blasted. Other plants have used the spray which was designed by the Falk Corp. for that purpose. As a safety measure screens can and should be provided for protecting other men working in or near that department.

It might be necessary, in many instances, to provide hoods for sand mixers. It is interesting to note today that most manufacturers producing that type of equipment are in a position to supply hoods. It is important that abrasive blast equipment be inspected regularly and kept in good repair. Today it is possible to purchase protective equipment which gives adequate protection to the abrasive blaster. It should be remembered that all abrasive blast operations, regardless of the material used, create an atmosphere which must be contained in the room so that it can be exhausted to the collecting unit.

While on the subject it might be of interest to consider possible savings which can be obtained with a good housekeeping program. For instance, we might start checking up on our valves, hose and pipe connections to decrease the cost in compressed air. Some plant engineers make a systematic check once a month or more often, by running the air compressor on a day in which no air is being used to determine how long a head can be held. Many serious leaks have been discovered in that manner.

Dr. E. G. Meiter, Employers Mutual Liability Insurance Co. of Wausau, Wis., recently made some observations with regard to the removal of fines from abrasive blasting material. Dr. Meiter found that material which remained on a 70 mesh screen is about the limit size of an effective abrasive material for the general run of foundry work. It is his recommendation that this finer material should be removed. In some particular studies he found that of the abrasive material in use 55.8 per cent remained on a 70 mesh screen; the remaining 44.2 per cent being rehandled dust. He concluded that the recirculating of the fines produced poor visibility in the blast room, retarded production and wasted compressed air. This particular condition pertains whether sand or steel abrasives are used.

A diligent survey of all existing equipment will pay you for the time spent. It is surprising what will be found. Many times, insignificant conditions which are remedied easily are the worst offenders.

In organizing a good housekeeping program make up your mind you are going to get rid of as much dust as is humanly possible. Responsibility does not end with the installation of proper facilities for dust control. It must be maintained adequately with regular inspections at all times. Therefore regardless of all abuses which the term silicosis has heaped upon this industry, the challenge must be met with the most effective means possible—prevention and control. Prevention of conditions which are contributary to the contraction of the disease and control of such conditions as may encourage or augment it. In other words—good housekeeping in the foundry should be our endeavor at all times.

Wins Golf Prize At Pittsburgh Outing

J. H. McCrady, of the J. H. McCrady Sand Co., Pittsburgh, turned in the low gross golf score of 79 at the annual outing June 15 of the Pittsburgh Foundrymen's association held at Pittsburgh.

The association has instituted a cup to be competed for annually by members and on which will be engraved the names of yearly winners.

I. B. F. Meets in Glasgow

(*Continued from page* 35)

come by the Lord Provost; the president of the reception committee, Sir James Lithgow, the president of the Chamber of Commerce and the director of the Royal Technical College supporting. Messages of greetings from various overseas foundry associations were read, including a cable from the American Foundrymen's Association.

Greetings were extended to foreign visitors, including A. H. Guy, president, South African Engineers' and Founders' Association, and managing director, Eclipse Tube Mill Liners (Proprietary), Ltd., Benoni, Transvaal, and A. H. Moore, Standard Brass Foundry, Benoni, Transvaal, honorary corresponding member of the Institute for South Africa; H. Jungbluth, of Germany, and H. H. Judson, of the United States. The Oliver Stubbs gold medals were then presented to the recipients, and the new president, H. Winterton, having been inducted in the chair by J. E. Hurst, delivered his address, which was followed by the presentation of papers.

Spends Day in Edinburgh

In the afternoon, the members attending the conference visited a number of works in the vicinity of Glasgow, and the annual banquet, at which about 325 guests were present, took place in the evening. On Thursday, June 11, the members left early in the morning for Edinburgh, where the conference was resumed at the Heriot-Watt College. In the afternoon, a visit was paid to the old castle and to the Scottish National Shrine, one of the most beautiful war memorials in existence. This was followed by a reception at the City Chambers by the Rt. Hon. the Lord Provost of Edinburgh, magistrates and councillors.

In the evening, the members returned to Glasgow, and at 8 p.m. Prof. A. L. Mellanby, D. Sc., The Royal Technical College, delivered the second Edward Williams lecture, the subject being: "Cast Iron and the Engineer." The next day, Friday, June 12, was devoted to an all-day excursion, by steamer, down the Clyde to the mouth of the river, the return being effected by rail.

In his presidential address, H. Winterton mentioned briefly the progress made in the foundry industry since the foundation of the Institute in 1904. He pointed out that the Institute had contributed to this progress, not only by its general activities, but by the encouragement given through the Oliver Stubbs medal, the Buchanan medal, the Surtees Memorial prizes, the Meritorious Services medal and, quite recently, by the medal offered by E. J. Fox, Stanton Ironworks, which is to be presented each year to recognize advances made in foundry metallurgy. Mention was also made of the facilities now offered to students, through the School of Foundry in Birmingham, and the university course in Sheffield.

The first paper presented following the presidential address was the French exchange paper: "Capillarity as a Factor in Foundry Practice," by Prof. Albert M. Portevin, Paris High School of Foundry, and Dr. Paul G. Bastien, Ecole Centrale des Arts et Manufactures, Paris. In the absence of the authors, this paper was presented in abstract by V. C. Faulkner, past-president of the Institute of British Foundrymen. The paper was confined to a discussion of the function of surface tension in the phenomena of castability and *searching*—the term adopted in the translation to define the penetration of the molten metal into the sand of the mold. The paper was of a somewhat scientific character and covered new ground on that phase.

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The next paper, "The Manufacture of Intricate Thin-Walled Steel Castings," was by Dr. R. Hunter and J. McArthur (member of the Institute). This paper describes how a solution was arrived at to the problem of manufacturing castings of an intricate nature and varying thin walls. C. H. Kain, Lake & Elliot, Ltd., Braintree, Essex, opened the discussion by stating that the steel castings sub-committee, of which he is chairman, is investigating defects in steel castings.

He pointed out that at present there are still a number of contradictory views in regard to the method to be followed in manufacturing steel castings: For instance, some founders say that the metal should be cast cool, whereas others say that it should be cast at as high a temperature as possible.

Referring to the position of a test-block on one of the castings illustrated in the paper, he expressed the opinion that such test-blocks should be placed so that the steel would pass through the casting before passing through the test-block. Referring to the question of molding sands, he thought that the high temperature at which metal is poured for thin-walled castings causes a strong erosive effect in the mold near the gate.

No Variation in Contraction

G. W. Brown, Austin Motor Co., Ltd., Birmingham, drew attention to the importance of the question of internal and external chills. One speaker asked what variations of contraction were noticed in relation to the sulphur content as between 0.04 and 0.06 per cent, and the authors replied that hardly any variation was noticed within those limits. J. E. Hurst, immediate past-president of the Institute, asked whether the aluminum paint used by the authors in the experiment was ordinary paint or a special preparation, and the authors replied that they employed a sodium solution.

Victor Stobie, Stobie Steel Co., Ltd., Dunston, Gateshead, Durham, pointed out that the size of the heads as shown in the illustrations given in the paper were not quite so large in actual practice as they seemed to be in the paper. Daniel Sharpe, president of the Scottish Branch, asked whether some of the castings described in the paper could be made in green sand, in answer to which question the authors stated that they were experimenting on that point.

Mr. Sharpe added that he believed that runners have as much to do with the successful manufacture of steel castings as the heads. C. H. Kain stated that he employed a combination of green sand and dry sand, one being used for the drag and the

(*Concluded on page* 78)

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(*Concluded from Page 76*)

other for the cope. He also thought that sulphur has dangerous effects over 0.04 per cent.

F. Hudson, Glenfield & Kennedy, Ltd., Kilmarnock, Scotland, presented a paper entitled "Composition and its Effect upon the Properties of Mold and Core-Sand Mixtures at Elevated Temperatures," in which he outlined in a general way the properties which could be expected in the materials mentioned during and after the casting operation, and stated that from the results obtained it was apparent that there was room for considerable improvement.

In opening the discussion, J. J. McClelland, honorary secretary of the Wales and Monmouth Branch, referred to the author's statement that the addition of sawdust to dry sand has long been a standard practice in many foundries but its action has never been fully understood. He said that, in his opinion, sawdust is more used for its permeability effects than for the presence of volatile matter.

In reply, Mr. Hudson stated that in his paper he was dealing with high temperatures and that, therefore, the volatile matter contained in sawdust had an effect at that temperature. He also said that blacking can be used for certain specialized work, but not for average castings.

Stresses Need for Experiment

R. Ballantine expressed the opinion that more experiments should be effected, and, relating his own experience in the manufacture of ingot molds, he said that the question of sand was not of more importance than the actual method of molding, and he stressed the danger of over-drying the sand. C. H. Kain asked how the author crushed his firebricks, and what degree of fineness he obtained, and in reply he was told that the results were more successful when the fines were not removed.

On Thursday, June 11, the technical session was held, during the morning, at the Heriot-Watt College, Edinburgh. At the opening of the session, the Meritorious Services medal was presented to James Smith, president of the Newcastle branch of the Institute, in recognition of the many years which he has devoted to the interests of the Institute, particularly in respect of the foundation of the Newcastle branch and its development during the past two years.

During the session, four papers dealing with similar subjects were presented in succession, the discussion thereon taking place after the presentation of the papers. The first paper was by J. E. Hurst, entitled "A Study of the Influence of Manganese and Molybdenum Additions to Cast Iron," in which he described an investigation carried out with the primary object of studying the influence of additions of manganese and molybdenum conjointly to cast iron.

The second paper was the German exchange paper, presented by H. Jungbluth, Krupp Co., Essen, Germany, on "The Influence of Wall-Thickness on the Mechanical Properties of Cast Iron." Dr. A. L. Norbury and E. Morgan, British Cast Iron Research association, contributed a paper dealing with "The Fracture of Pig Iron and Cast Iron," and the fourth paper was the American exchange paper: "The Founding of Pressure Castings," by H. H. Judson, foundry superintendent, Goulds Pumps, Inc., Seneca Falls, N. Y., in which the author described the two-cupola process using two types of mixtures, as employed in the works with which he is connected.

The general discussion was opened by F. J. Cook, who mentioned the case of a foundry which had run for a number of years with two mixtures for the manufacture of thick castings and where good results were consistently obtained; a relation between the two iron mixtures was found, and those two mixtures were melted separately and then mixed.

Dr. A. B. Everest, The Mond Nickel Co., Ltd., London, referring to the paper by Mr. Hurst, wanted to know why the author had chosen the particular combination of manganese and molybdenum additions described in the paper apart from the question of heat-treatment. The speaker was of the opinion that nickel-chromium iron appeared to be more interesting commercially. In reply, Mr. Hurst stated that he had used the particular combination of metals because he had undertaken his experiment purely for investigation purposes as regards the effect of that combination of alloys, and he said that he had not yet investigated nickel-chromium irons.

Referring to Mr. Judson's paper, Dr. Everest asked whether the process of pouring the metal quickly was in order to get it quickly into the mold or in order to have a modified structure, and Mr. Judson replied that it was not advisable to let the soft and the hard iron constituting the mixture remain together longer than necessary, and, therefore, it was advisable to pour quickly.

G. L. Harbach, Worthington-Simpson, Ltd., Newark-on-Trent, Nottinghamshire, referring to a statement in Mr. Jungbluth's paper that under certain conditions satisfactory agreement between the strength of a casting as a whole and that of a test-bar can be obtained if the diameter of the bar is made twice the wall thickness under test, stated that the sensitivity of test-bars varies with the quality of the pig iron. He also said that results of tests would only be conclusive if the average of a large number of tests were taken. He added that he did not think that the brinell hardness figure is a good measure for machining hardness.

Referring to Mr. Judson's paper, Mr. Harbach welcomed the classification of gray iron castings, as proposed by the author, into two broad classes of structural castings and pressure castings. He stated that, in his opinion, as good results could be obtained by using only one cupola in conjunction with the inoculation method as by using the two-cupola process. Referring to the difficulty of using low-carbon irons, he believed that it is better to keep around 3 per cent carbon, as this assures consistent results.

Mr. Judson replied that, his intention being to present a purely practical paper, he did not use the term *inoculation*, as he did not want to theorize. He also stated that he definitely wished to have low-carbon iron, but with at least 1.35 per cent silicon.

Composition Not Constant

J. G. Pearce, director, British Cast Iron Research association, referring to Mr. Hurst's paper, said that constant fracture does not necessarily mean constant composition of the iron. He stated that one cannot buy pig iron both by fracture and by analysis. Referring to the question of non-metallic inclusions, he said that this problem faces manufacturers of ferrous and non-ferrous castings forcibly.

C. E. Williams, past-president of the Institute, referring to Mr. Jungbluth's paper, mentioned that he had had experience of castings weighing several tons with walls 6 to 7 inches thick, and he had found that tensile test pieces cast on in such cases were not satisfactory for true results. P. A. Russell, S. Russell & Sons, Ltd., Leicester, convener of the sub-committee on cast iron, referred to Mr. Williams' remarks and said that the sub-committee was investigating the matter of tensile test pieces, and that Mr. Jungbluth's paper would be of great assistance in that connection; and while he agreed that a test-bar of a length ranging from 9 to 12 inches is not a practical proposition, he expressed the hope that the test-bar which eventually would be chosen would constitute a good compromise.

In reply Mr. Hurst stated hardness is not the only criterion to use, strength and other properties being equally important. He mentioned the use of test rings to obtain figures relative to internal stresses, and said it is assumed that movement of the edges after cutting a gap in the ring indicates internal stresses.

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Gray Cast Iron (*Chapter X*)

(*Continued from page* 34)

diameters, unetched, shows the path of a fracture (black) through a polished section of gray iron.

Note that in this low magnification micrograph the illumination chosen causes the flakes to appear as indentations. By observing closely the edges of the fracture, it may be seen that the fracture follows along the graphite flakes. Micrograph Fig. 108, unetched sample, magnified about 1000 diameters, depicts a very fine hairline crack extending across the metal from the tip of the black graphite flake to the left through to the tip of the other flake to the right. In Fig. 109, 1000 diameters, etched, a fine hairline crack is shown proceeding from the black graphite tip shown at one side of the micrograph and largely along the pearlite grain boundaries. Fig. 110, 500 diameters, etched, shows that at times the fracture may proceed through steadite crystals.

Strength of gray iron to a considerable degree is determined by the amount, size and distribution of the graphite flakes. Any condition that promotes greater discontinuity of the matrix lowers the strength of the metal. The effect of amount of graphite of course is obvious. Speaking of gray irons of given total carbon content, the lower the amount of combined carbon or pearlitic carbon, the greater the amount of graphite. Or with combined carbon content constant the greater the amount of total carbon, the greater the amount of graphite.

In a recent investigation, J. G. Pearce—*Bulletin*, British Cast Iron Research association, Vol. 6, No. 3, October 1932, pages 147 to 149,—conducted some careful tests on the effects of combined carbon. In one series he held combined and total carbon constant and varied the section. The results are shown in Fig. 111. The dotted line *B* represents the percentage of combined carbon. The full line *A* represents transverse rupture stress, tons (2240 pounds) per square inch. Similar results were shown by tensile, compression, impact, fatigue and other tests. Pearce concludes "It therefore is particularly important to appreciate that combined carbon is not an index to strength—."

It, of course, is true that the condition of the matrix (ferritic, pearlitic, sorbitic, martensitic, etc.) has an influence on the strength, and often a quite marked influence on hardness. However, the effects on strength frequently are overshadowed by the influence of the graphite flakes. The author has depicted the relationships of strength to structure in a general way in Fig. 112. The early chart by H. M. Howe indicating relationship of carbon content to strength has been shown in Fig. 31, page 28 of the May, 1935 issue of THE FOUNDRY.

Many investigators have tried to correlate strength and composition. Obviously these attempts are based on certain assumptions which may or may not be correct. For example, other factors than composition affect the degree of graphitization—for example cooling rate, and other factors mentioned in later sections. The modified diagram of Maurer, Fig. 113 suggests the common pearlitic range for castings between 0.4 and 3.5 inches thick. A number of diagrams many based on the original Maurer diagram are found in the literature of gray iron.

(*Concluded on page* 83)

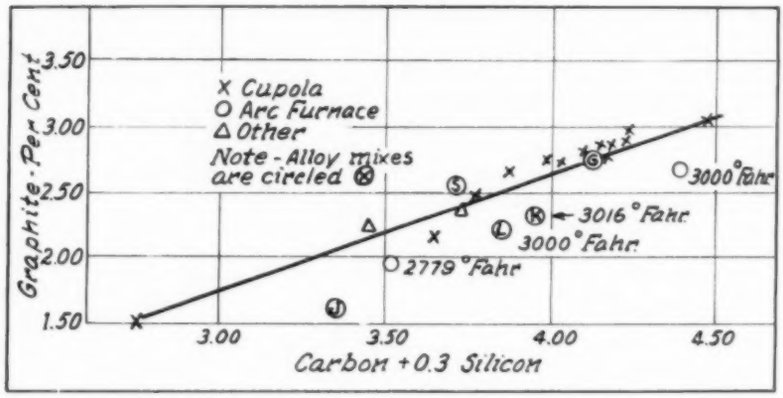

Fig. 114—Relation of graphite to carbon and silicon

Table XIII

Data on Chemical, Casting and Physical Properties of Irons

Iron	Average Chemical Analysis—Per Cent: Total Carbon	Silicon	Graphite	Combined Carbon by Difference	Combined Carbon by Color	Carbon plus 0.3 Silicon	Phosphorus	Manganese	Sulphur	Nickel	Chromium	Molybdenum	Casting Data: Mix: 100 Per Cent Minus Cast Iron Scrap — Steel Per Cent	Pig Iron Per Cent	Tapping Temperature Degrees Fahr.	Melting Unit	Data on Physical Properties: Tensile Strength lb. per sq. in. X 10^{-3}	Modulus of Elasticity Tension ½ Load lb. per sq. in. X 10^{-6}	Modulus of Rupture lb. per sq. in. X 10^{-3}	Modulus of Elasticity Transverse ½ Load lb. per sq. in. X 10^{-6}	Deflection 18" Span Inches	Shear Strength lb. per sq. in. X 10^{-3}	Endurance Limit X 10^{-3}	Compressive Strength lb. per sq. in. X 10^{-3}	Brinell Hardness 3000 Kg. Load	Izod Impact Un-notched-ft. lb.	Tensile Impact ft. lb.
A....	3.49	1.68	2.72	0.77	0.67	3.99	0.74	0.54	0.074				10	70	2597	Cupola	29.5	11.4	65.1	14.8	0.284	40.2	14.8	111.0	183	3.68	7.72
B....	3.53	1.67	2.69	0.84	0.76	4.03	0.68	0.56	0.076				12	67	2682	Cupola	28.5	10.5	62.2	13.7	0.293	38.0	14.1	107.2	183	3.96	7.75
C....	3.95	1.50	3.09	0.86	0.78	4.52	0.07	0.65	0.060				10	90	2701	Cupola	18.3	6.3	37.7	8.4	0.352	28.9	8.8	65.2	133	4.14	6.2
D....	3.25	2.08	2.66	0.59	0.61	3.87	1.99	0.53	0.050				13	67	2730	Cupola	21.3	10.5	33.3	12.6	0.141	27.5	12.3	90.9	179	2.17	4.4
E....	3.12	2.18	2.44	0.68	0.71	3.77	0.63	0.44	0.096				4	56	2669	Cupola	32.5	13.6	73.2	16.2	0.301	44.6	16.5	120.8	192	4.15	8.6
F....	3.61	2.06	2.93	0.68	0.55	4.23	0.75	0.52	0.062				10	75	2602	Cupola	22.4	8.7	49.2	12.4	0.251	33.0	11.4	91.0	163	3.60	6.1
G....	3.49	2.08	2.78	0.71	0.65	4.11	0.19	0.55	0.078	1.17	0.65		20	35	2894	Cupola	30.0	10.7	70.3	13.4	0.331	42.3	13.5	108.8	181	4.16	6.8
H....	3.59	2.50	2.75	0.64	0.52	4.14	0.43	0.74	0.062	..	..		10	35	2638	Cupola	31.5	12.8	63.9	15.6	0.245	42.2	18.6	116.1	196	3.28	9.2
I....	3.41	2.44	2.85	0.56	0.57	4.14	0.63	0.57	0.070	..	..		0	53	2649	Cupola	20.0	8.0	48.8	11.9	0.274	27.7	9.4	87.2	158	3.39	5.3
J....	2.61	2.58	1.73	0.88	0.83	3.35	0.06	0.77	0.105	1.08	0.09		85	..	2721	Cupola	51.5	16.2	92.5	18.6	0.272	61.0	24.0	156.6	269	5.69	11.7
M....	3.46	2.55	2.82	0.64	0.58	4.17	0.15	0.69	0.092	0.65	..		25	28	2730	Cupola	24.5	10.0	58.3	12.7	0.318	34.2	12.0	90.8	161	5.44	8.5
O....	3.43	2.35	2.75	0.68	0.59	4.13	0.20	0.73	0.092	..	..		13	41	2862	Cupola	25.0	9.7	58.7	12.7	0.341	35.5	11.8	95.8	163	4.91	8.3
S....	3.38	1.18	2.59	0.79	0.67	3.73	0.14	0.82	0.077	0.95	..		40	60	2687	Cupola	30.7	12.2	65.0	15.9	0.267	41.0	16.0	112.0	187	5.75	8.9
T....	3.49	0.53	2.16	1.33	1.48	3.65	0.33	0.42	0.133	..	..		0	2	2642	Cupola	35.0	15.0	75.2	19.4	0.294	47.8	....	123.5	207	....	....
V....	2.50	0.79	1.50	1.00	0.79	2.74	0.04	0.74	0.088	..	..		85	15	2655	Cupola	47.7	20.0	92.0	22.1	0.230	60.8	25.2	159.0	266	4.42	12.0
W....	3.79	1.47	2.99	0.80	0.76	4.23	0.12	0.73	0.083	..	..		37	63	2764	Cupola	18.3	6.6	47.0	10.2	0.336	30.4	8.2	77.9	139	4.19	6.0
K....	3.14	2.69	2.30	0.84	0.83	3.95	0.18	0.82	0.094	0.25	0.09	0.07	20	0	3016	Arc Furnace	35.7	12.6	69.7	14.8	0.295	44.3	16.5	115.9	194	3.86	7.5
L....	3.05	2.70	2.20	0.85	0.76	3.86	0.16	0.79	0.089	0.60	0.24	0.45	20	0	3000	Arc Furnace	39.2	14.3	81.8	16.6	0.301	44.2	18.2	131.2	228	5.06	11.5
U....	3.52	2.74	2.68	0.84	0.69	4.40	0.04	0.66	0.042	..	..	..	12	88	3005	Arc Furnace	19.4	6.0	48.3	8.3	0.370	29.6	10.0	72.8	146	3.65	5.6
Z....	2.79	2.44	1.94	0.85	0.77	3.52	0.03	0.50	0.060	0.50	0.09	..	68*	32	2779	Arc Furnace	56.7	16.4	111.7	18.0	0.490	57.1	28.0	135.7	236	8.16	19.7
R....	3.24	1.63	2.41	0.83	0.77	3.74	0.42	0.56	0.084	..	..	..	0	50	2687	Air Furnace	35.1	13.3	77.0	16.7	0.326	47.6	17.4	120.8	196	4.37	13.3
Q....	2.88	1.99	2.25	0.63	0.68	3.48	0.43	0.51	0.098	..	..	..	25	0	2894	Rocking Electric	40.9	14.8	84.2	16.2	0.439	47.3	19.6	119.1	190	6.18	11.7
Y....	3.07	1.97	2.22	0.85	0.77	3.66	0.40	0.63	0.072	..	..	..	12	50	2791	Rotary Coal	29.2	12.7	73.5	15.7	0.308	44.3	16.2	124.5	215	3.86	7.5

*Calcium Silicate added.

Melting Iron in the Cupola

by

J. E. Hurst

CHAPTERS

1—Historical
2—Construction
3—Operation
4—Charging
5—Receivers
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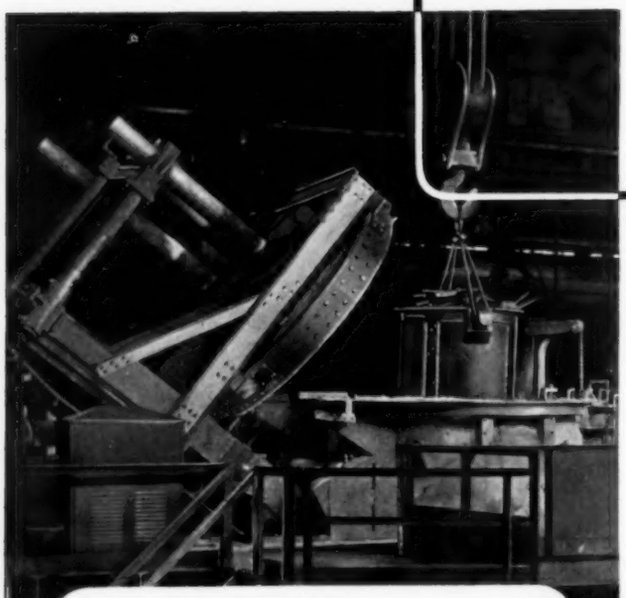

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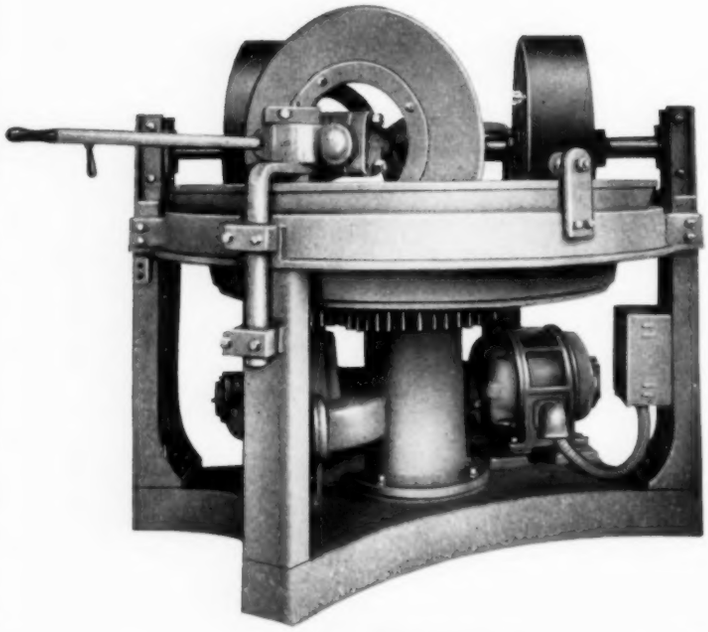

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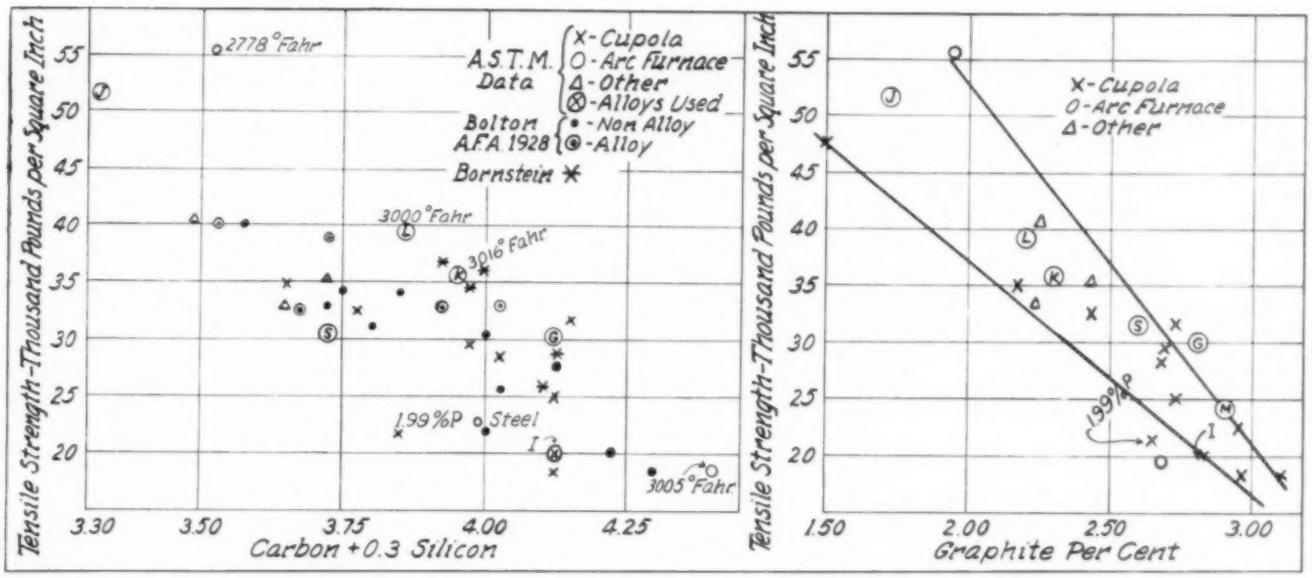


Fig. 115—Diagrammatic representation of relation between tensile strength, and carbon and silicon. Fig. 116—Percentage, size and distribution of graphite affect strength

(*Concluded from page* 80)

In the author's experience the strengths of irons made up from similar stocks melted under like conditions and cooled at the same rates vary rather closely with the sum of the percentage carbon plus 0.3 times the percentage silicon. The data of the impact investigation—report of Subcommittee XV of Committee A-3, *Proceedings* of the American Society for Testing Materials, Vol. 33, part 1, 1933—affords an opportunity to study the effects of a wide variety of compositions and melting conditions on bars cast to the same nominal size. The more pertinent data in highly condensed form is given in Table XIII. Incidentally, this report should be in every foundry library.

In Fig. 114 is shown the surprisingly close relationship of graphite percentage to the sum (carbon plus 0.3 silicon). In Fig. 115 is shown the relationship of tensile strength to the sum (carbon plus 0.3 silicon). Several results published by H. Bornstein and by the author are included in this diagram. The general trend is quite plain and on close study reasons for some of the greater variations become apparent.

A somewhat similar condition of affairs is noted in Fig. 116. It is evident that it is not only percentage, but also size and distribution of graphite which affect strength. In Fig. 117, which should be compared carefully with Fig. 114, the relationship of the sum (carbon plus 0.3 silicon) to a relative elastic modulus is depicted. Fig. 118 shows the relationship between the graphite percentage to a relative elastic modulus.

The various charts shown in Figs. 114 to 118 indicate the close relationship existing between the degree of graphitization and the carbon and silicon content of the iron, and the general relationship of these factors to strength. Too, it is suggested by these diagrams that not only is amount of graphite important but also the size and distribution of the flakes and the nature of the matrix must be taken into consideration. In succeeding chapters, some of these other variables are considered in greater detail and specific consideration given various engineering properties.

Founders Hold Annual Golf Tournament

The eastern division of the Steel Founders Society of America, New York, held its annual golf tournament June 9 at Aronimink country club, near Philadelphia. About 40 steel foundrymen attended the meeting. Lee C. Wilson, Reading Steel Casting division, Reading-Pratt & Cady Co. Inc., Bridgeport, Conn., is director-chairman.

Following a brief business session, six foursomes competed for the Powell cup and other handsome prizes. Clarence Tolan Jr., Dodge Steel Co., Philadelphia, acted as chairman of the golf committee. First prize was won by R. H. Nesbitt, Pennsylvania Electric Steel Casting Co., Hamburg, Pa.

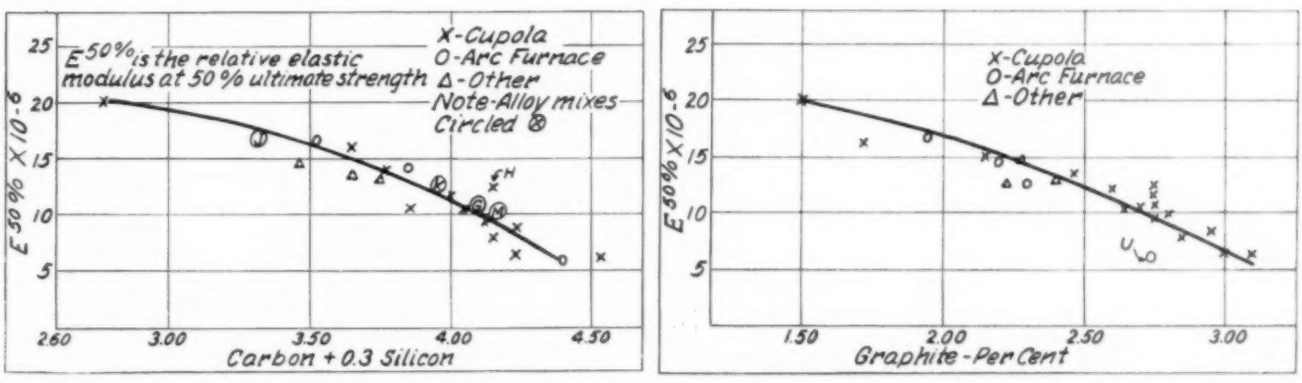
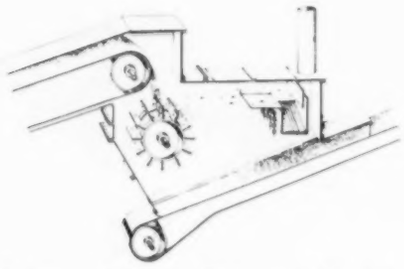


Fig. 117 (Left)—Relation between carbon and silicon, and relative elastic modulus. Fig. 118 (Right) — Percentage of graphite is related to elastic modulus

Sand Unit Performs Two-Fold Duty

Link-Belt Co., Chicago, has introduced a new foundry sand preparation unit illustrated in the accompanying diagram. This separator is claimed to perform the double function of both aerating and mixing the sand before delivery to the molder's hoppers and separating the shot metal, pebbles and small refuse from the sand which may not have



A screen-bottom chute permits any sand traveling with refuse to be diverted

been caught by screen or magnetic pulley.

A power-driven, paddle-type beater with sand and refuse collecting and discharging media, all enclosed within a steel housing, make the unit one of few parts. This housing is fitted with an air-release pipe and other means for preventing any blast of air along the belt conveyor which receives the aerated sand and carries it away from underneath the machine to the respective molder's storage hoppers. As the refuse travels forward, close to the top of the housing, it is deflected by a baffle which permits escape of air currents and assures delivery of refuse to its chute. A shield of chains in front of the refuse chute keeps the sand from building up at this point. A screen-bottom chute permits any sand traveling with the refuse to be diverted to the aerated-sand conveyor.

Introduces Small Tools

Yates-American Machine Co., Beloit, Wis., has introduced a line of woodworking machines for home, school and light industrial use. Construction features include fully-enclosed moving parts, a positive driving principle delivering a flow of power through a range of speeds from 800 to 4000 revolutions per minute and adaptability for either bench or pedestal mounting. The company's line consists of floor and bench type lathes and drill presses, hand jointers, circular saws, 12 and 24-inch jig saws, single and double grinders, belt and disk sanders. A combination consisting of a jointer and circular saw mounted together on a pedestal driven from one motor, and a belt and disk sander similarly mounted are produced.

Cutting Attachment

Linde Air Products Co., New York, recently has introduced an oxy-acetylene cutting attachment. It is said to handle light sheet metal as well as all but the heaviest work at speeds and efficiency equal to those of the full size cutting blowpipe. The attachment operates on either low or medium-pressure acetylene.

A streamline injector and an improved type cutting valve with removable seat centralized under the cutting lever are features of the mechanism. Four 90-degree changes of direction, pressure-forged bronze body and manganese bronze head complete construction details of this recently developed unit.

Rubber Hose

Electric Hose & Rubber Co., Wilmington, Del., has placed a new type of rubber hose on the market recently. Designed for welding equipment and similar services, the tubing has a special cord-wound reinforcement between the first and second braid, giving it a higher burst limit. It is claimed that a single length of this non-kinking hose is all that is necessary for equipment which heretofore required two separate lengths.

Fan Cooled Motor

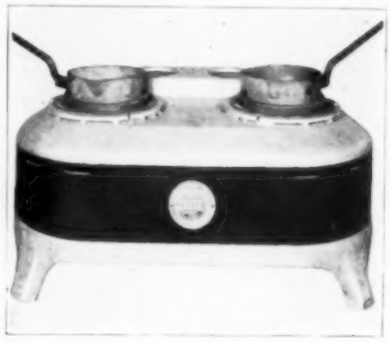
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has designed a totally enclosed, fan cooled, direct current motor for general industrial service and use in automobile factories, foundries, etc., where abrasive and metallic dust is present. The motor is said to be constructed so as to exclude all foreign matter from the interior. Commutator and brushes are accessible by removing only one cover. Motor may be mounted close to a wall or gear box at the pulley end without interfering with the free flow of ventilating air.

Bench Grinder

Independent Pneumatic Tool Co., Chicago, has introduced a 6-inch bench grinder said to be particularly fitted for general grinding, polishing, buffing and wire brush work in factories, garages, etc. Ball bearing construction throughout, enclosed motor, adjustable tool rests, are features of design in the unit. It is supplied for connection with either alternating or direct current.

Aluminum Melting Furnace Simple in Design

Simplicity of design, efficient heat, low fuel consumption, short melting time, nonabsorption of gas by the metal, metal poured directly from pot into mold and low maintenance cost are among the claims advanced for the aluminum melting furnace shown in the accompanying illustration and made by the Kindt-Collins



Each unit may be operated independently of the other

Co., 12697 Elmwood avenue, Cleveland.

A hand lever on an indicator scale may be set to regulate the proper volume of gas and air. A power switch automatically is turned on and off at the proper time thus eliminating the usual valve adjustment. One of the features is a preheater where otherwise wasted heat is employed to preheat the metal before it is placed in the pot.

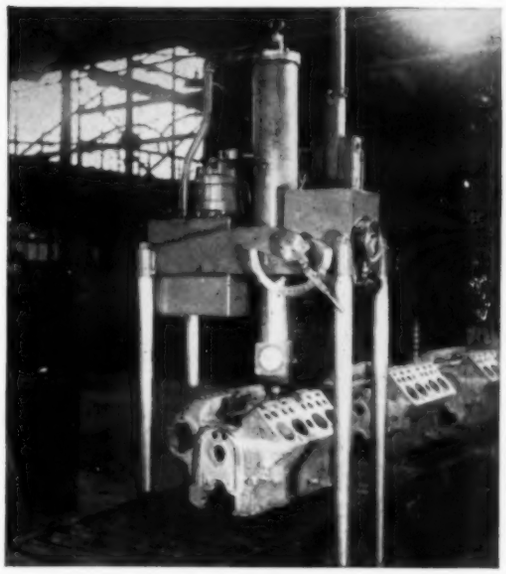
The special molded refractory lining is backed by insulating material and as a result the maximum temperature is concentrated on the pot. A stream of air circulating through an air chamber keeps the outside of the furnace cool. Melting pots used in connection with the furnace are a special alloy cast iron. The metal is poured directly from the melting pot into the mold. Furnaces are built in several sizes single or twin units, melting pot capacity 30 or 50 pounds and are supplied either with or without motor driven blowers.

Electric Heating Pliers

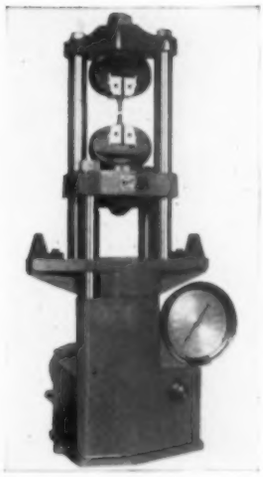
Ideal Commutator Dresser Co., Sycamore, Ill., has developed a set of electric heating pliers which is said to take the place of an open-flame blow torch or burner. When the wire connections are plugged into an alternating current lighting circuit, current passes through the transformer and heats the jaws to a white-hot temperature. The unit has renewable carbon jaws, insulated fibre handles, heat control and switch and is portable. The cord connection is 10 feet long and two 6-foot cables connect transformer and pliers.

DIRECT READING BRINELL MACHINE

Standard Direct Reading Brinell Machine with special fixture testing inside of cast iron brake drums. This machine is adaptable to any shape of casting.



Direct Reading Conveyor Brinell.
Brinell testing cylinder blocks, etc., on conveyor. Tests made at any height without adjustment.



Tensile, Transverse and Compression Testing.
An accurate, practical testing machine. Small in size. Large in capacity.
Extremely simple to operate and low in cost.

No grinding or microscope required on Direct Reading Machines.

These machines also available without the Direct Reading Feature.

DETROIT TESTING MACHINE COMPANY

5137 Trumbull Ave. **Detroit, Mich.**

ALWAYS DEPENDABLE

HIGH GRADE CLAYS

Used in the manufacture of our

SLEEVES AND NOZZLES

Assures Foundrymen maximum service and dependability.

There is a size for every need.

—WE SOLICIT YOUR ORDER—

Established HAWS 1856
REFRACTORIES Co.
MAGNESIA BRICK SILICA BRICK FIRE BRICK
PLANTS: JOHNSTOWN, PA. AND HAWSTONE, PA.
OFFICE: JOHNSTOWN, PA.

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LANSDALE FOUNDRY BUILDINGS

Irregular Lot:—206′ Frontage on Reading R. R. With Siding, and Approx. 190′ on Iron Ave.

Located in the Thriving Town of Lansdale—½ Hour by Train from Philadelphia. A Progressive Penna. Dutch Locality:—of Diversified Industries—an Excellent Labor Market—With a Population of 10,000 on the Main Line of the Reading R. R.

Adjacent to the Plants of the Hajoca Corporation, The Weaver Steel Co., The Werner Foundry and The Lansdale Porcelain & Enamel Co.

***Property Contains:*—Foundry Buildings, Office Building, & 2 Warehouses**

***Property Includes:*—Cupolas, Scale, Etc., Etc. 7.68 Acres of Ground Extra.**

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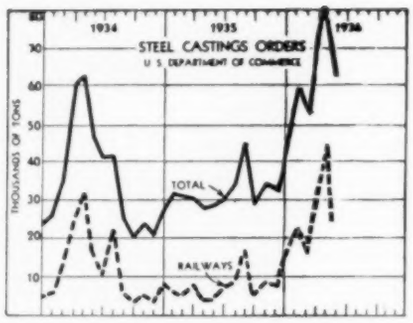
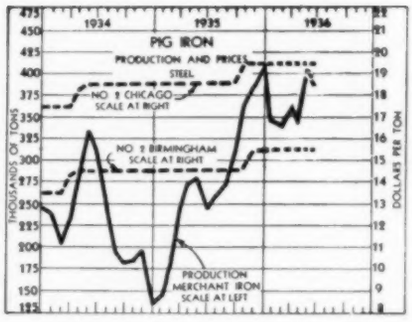
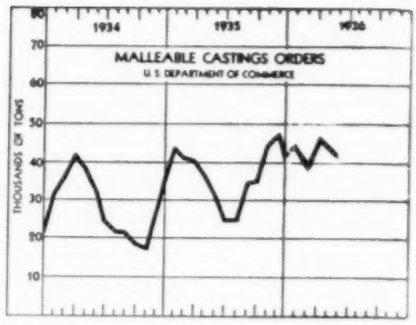






Foundry Activities

Reflect Industrial Trends

INDUSTRIAL STEEL CASTINGS CO., Toledo, O., has purchased a large plot of ground on Millard avenue for the construction of storage warehouses. Also, an expansion program is under way at the plant, including the building of a new cleaning department, an extension for an additional melting furnace, addition of several new cranes and other similar improvements. Joseph Tillman is vice president of the company.

* * *

The Cooper - Bessemer Corp., Grove City, Pa., suffered $2500 loss to its foundry recently at Grove City.

* * *

American Foundry Inc., 906 Date street, Los Angeles, is planning to enlarge its factory.

* * *

Shovan Brass Corp., Peoria, Ill., has been incorporated by Jacob B. Olwin, Carl M. Seipt, Philip Z. Horton and Edward T. Van Arsdel.

* * *

Bettendorf Co., Davenport, Iowa, was scheduled to resume operations on a small scale in its foundry about July 1.

* * *

J. B. Morris Foundry Co., Cincinnati, O., has been purchased by the Glow Electric Co., Cincinnati, headed by Alex Glowicki.

* * *

Fairbanks, Morse & Co., Chicago, is making additions to its plant in Beloit, Wis. Cost is estimated at $100,000.

* * *

Pittsburgh Porous Drain Pipe Co., Pittsburgh, expects to reopen the plant leased from Cyclops Foundry Co., Monongahela, Pa. Harry V. Bovard, Mt. Lebanon, Pa., is in charge of remodeling and John F. Edmonds, district manager of Anchor Packing Co., Pittsburgh, will head the pipe company.

* * *

Saginaw Malleable Iron Division of the General Motors Corp., Detroit, plans to construct two additions to its local plant in Saginaw, Mich.

* * *

Twentieth Century Heating & Ventilating Co., Edison avenue, Akron, O., was damaged by fire recently. John Kerch is president and general manager.

* * *

Betz Foundry, Bristol street and Pennsylvania railroad, Grand Rapids, Mich., recently suffered a $2500 loss by fire.

* * *

Howard Foundry Co., 111 West Washington street, Chicago, has been incorporated by James H. Cronin, Harry A. Quinn and David Jetzinger, with Jetzinger & Quinn as correspondent.

* * *

Trenton Malleable Iron Co., New York and Ferrier avenues, Trenton, N. J., has sold its foundry machinery, machine shop equipment, tools, raw surplus materials and office equipment to S. L. Weiswasser, Philadelphia.

* * *

C. & G. Foundry, 2440 Yandes street, Indianapolis, is expanding its plant to include 6000 square feet of additional space. A cupola is to be built and alloyed light castings will be made, leaving the former plant for large castings.

* * *

Officials of the Wooster, O., plant of the United Engineering & Foundry Co. have announced that contracts have been let in a modernization program which will cost $125,000. The program consists of the installation of new machinery and does not include any expansion or building program.

* * *

Homer Furnace & Foundry Corp., Coldwater, Mich., has opened its plant recently on the decision of a recent board of directors meeting. Circuit court action commenced for

RAW MATERIAL PRICES
July 8, 1936

Iron	
No. 2 foundry, Valley	$19.50
No. 2 Southern, Birmingham	15.50
No. 2 foundry, Chicago	19.50
No. 2 foundry, Buffalo	19.50
Basic, Buffalo	18.50
Basic, Valley	19.00
Malleable, Chicago	20.00
Malleable, Buffalo	20.00
Charcoal iron, furnace	22.00
Coke	
Connellsville beehive premium	$ 5.35 to $5.50
Wise county beehive coke	4.30 to 5.00
Detroit by-product coke	9.00
Scrap	
Heavy melting steel, Valley	$13.00 to $13.50
Heavy melting steel, Pitts.(dlv.)	13.50 to 14.00
Heavy melting steel, Chicago	13.00 to 13.50
Stove plate, Buffalo	10.00 to 10.50
Stove plate, Chicago	7.50 to 8.00
No. 1 cast, New York	9.00 to 9.25
No. 1 cast, mchy., Chicago	12.00 to 12.50
No. 1 cast, Pittsburgh	14.00 to 14.50
No. 1 cast, Philadelphia	14.00 to 14.50
No. 1 cast, Birmingham	10.50 to 11.50
Car wheels, iron, Pittsburgh	14.00 to 14.50
Car wheels, iron, Chicago	13.25 to 13.75
Railroad malleable, Chicago	15.50 to 16.00
Malleable, Buffalo	15.50 to 16.00
Nonferrous Metals	**Cents per pound**
Castings copper, refinery	9.15
Straits tin	43.50
Aluminum, 99 per cent	19.00 to 21.00
Aluminum, No. 12 (Secondary, standard)	16.25 to 16.75
Lead, New York	4.60
Antimony, New York	13.00
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	4.75

Homer Furnace & Foundry Corp., Coldwater, Mich., has opened its plant recently on the decision of a recent board of directors meeting. Circuit court action commenced for

OVER 40 YEARS

of Service In The Foundry Field

● It is a fine testimonial to the uniform quality of our products and efficiency of our service that customers of more than forty years standing are still obtaining all their fire clay requirements from us.

Prompt shipments in mixed carloads, if desired.

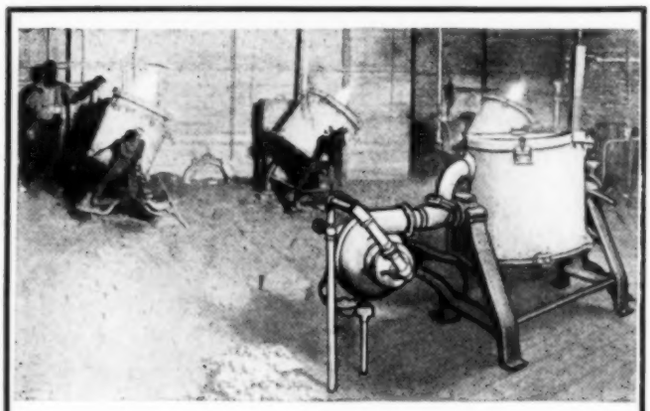
● Fine Ground and Rolled Flake for Cupola and Ladle Lining and for all furnace uses.

● Specially prepared high grade pulverized Black Horse brand Fire Clay for facing, bonding and laying fire brick.

If you have never used West Virginia Fire Clay—send us your inquiry.

WEST VIRGINIA FIRE CLAY MANUFACTURING CO.

Diamond Bank Building
PITTSBURGH, PA.



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HAUSFELD MELTING FURNACES

Not infrequently the installation of Hausfeld Melting Equipment, burning gas or oil, reduces production costs of uniform analysis alloys from half to two thirds. This saving quickly amortizes the cost of the equipment and converts operative losses into substantial profits.

Write for book on comparative melting costs, based on actual records from representative metal melting plants.

THE CAMPBELL-HAUSFELD COMPANY
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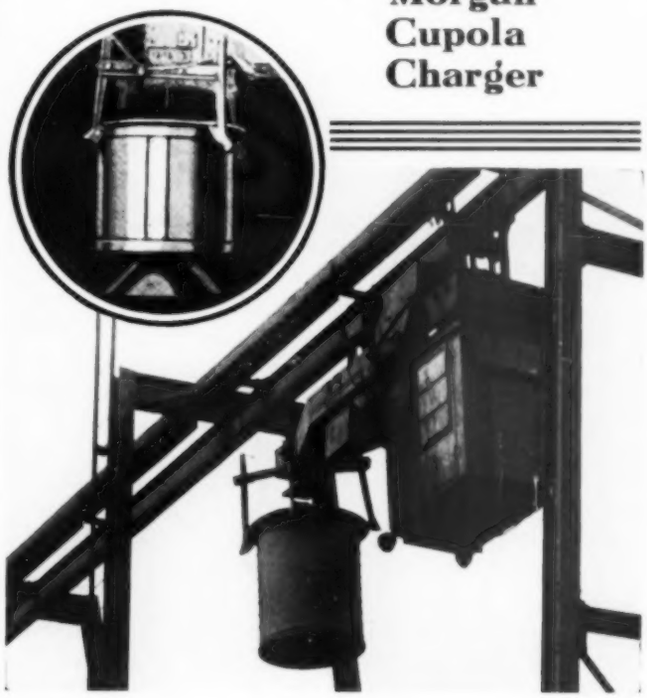
CHARGING COSTS *DECREASED*, EFFICIENCY *INCREASED* WITH

The **Morgan Cupola Charger**



ACTUAL figures show a decrease of 50% to 75% in labor cost of material charged. One man in the cab of charger together with two or three men on the weighing floor will keep several cupolas running at full capacity without delay. A MORGAN CUPOLA CHARGER will soon pay for itself.

There is not only a decrease in labor cost, but also a greater efficiency in charging. By means of the conical bottom of the MORGAN bucket (see insert) the operator in the cab is able to deposit the charges of iron and fuel uniformly over the furnace bed and to the outside, causing the air to pass up through the center of the cupola. This protects the lining from undue heat. Pulverization of fuel is prevented and more uniform and thorough melting accomplished.

Avoid the increasing difficulty of securing competent labor by installing a MORGAN CUPOLA CHARGER now. You are paying for it anyway. Write for details today.

Lake Erie Engineering Corporation

86 KENMORE STATION BUFFALO, N. Y.

the dissolution of the corporation probably will be discontinued.

* * *

Gray Iron Foundry & Mfg. Co., Reading, Pa., now in receivership, will be appraised by John L. Ennis and Raymond Hauck, Reading, according to a recent announcement by Judge Schaeffer, Reading. Herbert Parsons is receiver for the company.

* * *

Index of foundry equipment orders, according to a report of the Foundry Equipment Manufacturer's association, Cleveland, was 165.1 in May, 1936 as compared with 134.0 in April, 1936 and 100.7 in May, 1935. Index of shipments was 146.7 in May, 1936, 105.1 in April, 1936, and 67.0 in May, 1935.

* * *

Vulcan Mold & Iron Co., Latrobe, Pa., following considerable experimentation and test, is in process of changing over plant equipment to manufacture its ingot molds by the cement bonded sand method or Randupson process. The company expects to be manufacturing its entire output by the new process by mid-July.

* * *

Approval of the plan of reorganization of the Universal Pipe & Radiator Co. and the Central Foundry Co., both of New York, provides for the dissolution of the Universal Pipe & Radiator Co. and seven subsidiary companies and the retention of two operating companies. The reorganized company will be known as the Central Foundry Co.

* * *

Wheeling Mold & Foundry, Wheeling, W. Va., has been authorized by the Continental Roll & Steel Foundry Co., Chicago, to undertake its program of expansion involving the expenditure of $100,000. Completed improvements to the Wheeling plant will not only modernize present machinery but will increase its capacity. All of the improvements authorized under the appropriation will be centered in the machine shop which has been operating steadily.

* * *

Cleveland Trade school, Cleveland, in co-operation with the Associated Industries of Cleveland, Guarantee Title building, is taking steps toward the expansion of the public school system for training in the industrial field. Transfer of machine shop equipment from the school to East Technical high school is now going forward and by fall the machinery of both schools will be available for this work at the high school. This move also will permit the expansion of the foundry, patternmaking and other departments at the trade school.

New Trade Publications

DUST CONTROL—Pangborn Corp., Hagerstown, Md., has issued an interesting and instructive booklet on industrial dust control through exhaust systems. Written by W. O. Vedder of the Pangborn Corp., the booklet is intended as a general descriptive outline for the purpose of acquainting plant executives with the means of controlling industrial dusts at the source of production. Operation, maintenance and design features of various dust collecting apparatus are given.

FLOODLIGHTS — Crouse-Hinds Co., Syracuse, N. Y., presents in its latest booklet a summary and index of sports floodlighting, with specifications, suggestions, details and layout for other types of lighting.

HOISTS—McCollum Hoist & Mfg. Co., Downers Grove, Ill., has issued two illustrated bulletins on electric and chain hoists. Capacities, operating speeds and dimensions are given, including information, sizes and weights.

DUST COLLECTORS — American Foundry Equipment Co., Mishawaka, Ind., illustrates and describes features of its dust collector in a recent publication, with a listing of the dusts or materials which can be collected by this system.

HANDLING EQUIPMENT — Jeffrey Mfg. Co., Columbus, O., has prepared a publication which presents pictorially the company's line of materials handling equipment. Information is included on specifications and prices of sprockets, chains, transmission machinery, spiral and elevator conveyor parts.

APPLIANCES—National Electric Appliance Co., Cleveland, has issued a folder on its line of equipment, including instructive suggestions on processing and data on such of the company's products as control equipment, portable immersion heaters, cartridge and rectangular radiant units, industrial air heaters, and space and oven heaters.

FLASKS—John T. Hepburn Ltd., Toronto, Ont., presents in folder form its aluminum slip flasks and jackets, aluminum round slip flasks and jackets, and its portable sand preparation machine. Specifications, uses and advantages are listed.

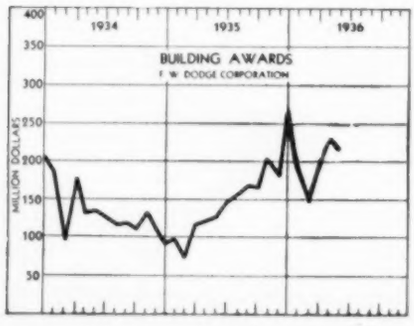
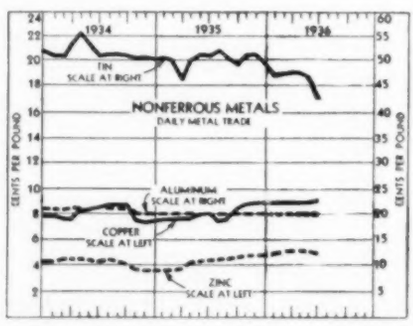
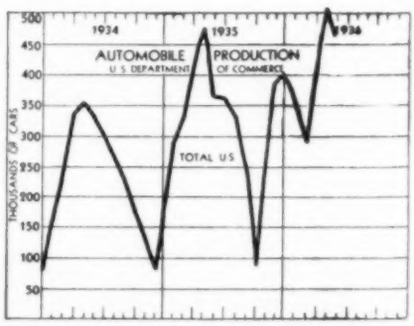
HEATERS—Young Radiator Co., Racine, Wis., has prepared a publication giving information on unit heaters with or without thermadjust control. A capacity table is given, roughing-in and overall dimensions are outlined, and features of construction presented.

TRAMRAIL SWITCHES — Cleveland Crane & Engineering Co., Wickliffe, O., in its fourth folder of a group of six, displays typical installations of tramrail switches for light and heavy service and presents features of construction and use.

COMPRESSORS—Sullivan Machinery Co., Michigan City, Ind., presents its line of two-stage, air-cooled, V-type, single acting stationary compressors in a bulletin recently issued. Design, installation, available sizes and construction details are featured.

INDUCTION MOTORS — Wagner Electric Corp., 6400 Plymouth avenue, St. Louis, gives service instruction for its capacitor-start, induction-run motors, in a recent pamphlet. A listing of troubles most frequently encountered also is given. The subject has been prepared in outline form.

GRINDING WHEELS — Chicago Wheel & Mfg. Co., West Monroe street, Chicago, gives specifications, diameters and definitions of vitrified and silicate bonded, resinoid and rubber bonded, and specially shaped grinding wheels produced in its plant, in a recent publication. A table of speeds is included.

OVENS AND DRYERS — Gehnrich Corp., Long Island City, N. Y., features in a recent publication the construction, ventilation and circulation, safety and methods of handling of the company's industrial ovens and dryers. Photographs of various layouts and installations are shown and described in detail.

BRONZE-WELDING — Linde Air Products Co., New York, has made available a booklet entitled "How to Bronze-Weld," summarizing information on bronze-welding and bronze-surfacing. This is a practical presentation of the fundamental theory and technique of these two processes. Step-by-step general procedure, advice and special information are covered. Preheating is given a major consideration.